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ERRATA.

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Page 844, line 4 from top, read 1883, instead of 1783.

,, 846, ,, 13 from top, read 'numerous tracks of otters' not *others*.

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Chulalongkorn University Library	Bangkok.
Daly College, The Principal	Indore.
Dayaram Jetharam Sind College	Karachi.
Forest Research Institute and College, The Forest Botanist	Dehra Dun.
Forest Research Institute and College, The Principal	Dehra Dun.
Gujarat College, The Principal	Ahmedabad.
Gwalior, Victoria College, The Principal	Gwalior.
Haffkine-Institute, The Director	Bombay.
Indian Lac Research Institute	Namkum.
Institute of Plant Industry, The Director	Indore.
Intermediate College, The Superintendent	Bangalore.
Karnatak College, The Principal	Dharwar.
King Institute, The Director	Guindy.
Lawrence Memorial Royal Military School	Lovedale.
La Martiniere College, The Principal	Lucknow.
Lingnan University Library	Canton.
Ludhiana, Government College, The Principal	Ludhiana.

Colleges and Scientific Institutions—*continued.*

Madras Christian College, The Librarian	Madras.
Madras Forest College, The Principal	Coimbatore.
Maharaja's College, The Principal	Ernakulam.
Mayo College, The Principal	Ajmer.
Mrs. A. V. N. College, The Principal	Vizagapatam.
Noble College, The Principal	Masulipatam
Nowrosjee Wadia College, The Principal	Poona.
Oakgroove School, The Principal	Mussoorie.
Osmania University College	Hyderabad, Dn.
Pittapur Rajah's College	Cocanada.
Presidency College, The Principal	Madras.
Rajkumar College	Raipur.
Rajaram College, The Principal	Kolhapur.
Royal College of Medicine, The Professor	Baghdad.
Royal Institute of Science, The Principal	Bombay.
Samaldas College	Bhavnagar.
Secondary Training College	Bombay.
St. Joseph's College, The Principal	Teppakulam.
St. Mary's High School	Bombay.
Trivandrum, H. H. Maharaja's College for Women	Trivandrum.
University College, The Principal	Rangoon.
University College, The Principal	Colombo.
Victoria Technical Institute, The Curator	Nagpur.
Wilson College, The Principal	Bombay.
Women's Christian College	Madras.
Colombo Museum, The Librarian	Colombo.
Colvin, Lt.-Col. E. J. D. (I.A., C.I.E)	Srinagar.
Congreve, C. R. T.	Nilgiris.
Conley, Andrew	Jamaica.
Connor, Maj.-General Sir Frank (*Kt.*, D.S.O., F.R.C.S., I.M.S.)	Madras.
Conservator of Forests, Bhopal State	Bhopal.
Conservator of Forests, Cochin Government	Chalakkudi.
Conservator of Forests, Working Plan Circle	Maymyo.
Conservator of Forests, The Chief	Srinagar.
Conservator of Forests, The Chief	Bombay.
Cooper, Khan Bahadur D. B. (M.L.A.)	Satara.
Cotten, Capt. J. C.	Baroda.
Cowasji Jehangir, Sir, *Kt.* (K.C.I.E., O.B.E.)	Bombay.
Cowper, G. St. John	,,
Cox, C. E. C. (I.F.S., F.Z.S.)	Amraoti.
Coyajee, Miss R. H.	Bombay.
Crawford, William G. (I.F.S.)	Rangoon.
Crofton, R. M. (I.C.S.)	Nagpur.
Croix, O. H. de St.	Delhi.
Crombie, A. D. (I.C.S)	Madras.
Cunningham, G. (C.I.E., O.B.E., I.C.S.)	Peshawar.
Currie, A. J.	Bombay.
Currie, The Hon'ble Mr. Justice M.M.L. (I.C.S)	Lahore.
Dabholkar, Major A. Y. (I.M.S.)	Bombay.
Dadachanji, R. R.	,,

Dalal, N. B.	Bombay.
Dalal, M. P. M.	,,
Dalal, Miss Perin P. M.	,,
Dalal, Dr. Phiroz A. (L.M.S., D.T.M. & H.)	,,
Danson, J. W. W.	Rangoon.
Darby, A. W. (O.B.E.)	Chandia.
Darjeeling, The Cruator, Nat. Hist. Mus.	Darjeeling.
Daultana, Khan Bahadur Mian Ahmadyar. (M.L.C.)	Multan.
Davenport, Major C. (O.B.E., R.A.V.C.)	Bombay.
Daver, Framroze A.	,,
Daver, The Hon'ble Mr. J. D. (Bar-at-Law)	,,
Daver, S. R.	,,
Davey, G. H.	Kottayam.
David, Meyer I.	Bombay.
Davidson, E. R.	Sudan.
Davidson, M. N. D.	Siam.
Davies, T. G. B. (A.R.S.M., ST.M.I.P.T.)	England.
Davies, Capt. V. K. N. (I.A.)	Bombay.
Davis, D (I.F.S.)	,,
Davis, G. (I C.S.)	England.
Davis, P. W. (I.F.S.)	Coimbatore.
Davis, Dr. W. St. T.	Dwarbund.
Dawkins, C. G. E. (I.F.S.)	Rangoon.
Dean-Drummond. Lt.-Col. J.D.	Madras
Delacour, Mons. Jean	France.
de Mello, Prof. Col. I. F.	Nova Goa.
Dent, T. V. (I.F.S.)	Darjeeling.
Deo, Sri Balavadra Narayan Bhunj	Keonjhargarh.
DeRhe Philipe, C. W. V. (F.E.S.)	London
Deutsche Forschungsgemeinschaft, The Beschaffungsamt	Berlin.
Deutsches Entomologisches Institut der Kaiser Wilhelm	,,
Dewas, Sir Prince Vikram Singrao	Kolhapur
Dickins, M J.	Bombay.
Dickson, Lt.-Col. H. R. P. (C.I.B.)	Persia.
Dinajpur, Maharaja Jagadish Nath Ray	Dinajpur.
Dinshaw, Kaikobad Cowasjee (I.P.)	Bombay,
Director of Museums, S. S. & F. M. States	Kuala Lumpur.
Dixie, Capt. W. J.	Karachi
Dobson, F.	Panposh.
Dods, W. K. (C.I.E.)	Calcutta.
Donald, C. H.	Dharmshala.
Donald, Lt. J. O. S.	Tonk
Donovan, Lt.-Col. C. (I.M.S.)	England.
Doyle, Lt.-Col. E. E.	Poona.
Drake-Brockman, D L. (C.I.E., I.C.S.)	Lucknow.
Drake-Brockman, Lt. R. F. H. (R.A.)	Bangalore.
Dubash, J. K.	Bombay.
Duke, A. H.	Bangkok.
Dunbar-Brander, A. A. (O.B.O. I.F.S.)	Scotland
Duncan, Capt. D. L.	Loralai.

Duncan, John E. (P.W.D.)	London.
Duncan, P. R. (I.F.E.S.)	Dehra Dun.
Duncan, Lt.-Col. W. E. (D.S.O., M.C., R.A.)	Mhow.
Dunsdon, A. C.	Moradabad.
Durand, C. H. S.	Bombay.
Dyer, Dr. J. C.	Meerut.
Dyson, R. A.	Bombay.
Earle, P. K.	Rangoon.
Eates, K. R.	Sukkur.
Edmonds, A. C.	Bellary.
Edwards, M. Vincent (I.F.S.)	Rangoon.
E. I. Railway, European Institute	Dhanbad.
Eliot, John N.	Ferozepore.
Elliot-Lockhart, Lt. Wm.	London.
Elliot, A. (C.I.E.)	,,
Ellis, E. T. H.	Calcutta.
Ellis, Ralph, Jr.	California.
Emerson, Gerald H. (I.C.S.)	England.
Emerson, Capt. J.	Bombay.
Evans, E. J.	Calcutta.
Evans, Col. G. H. (C.I.E., F.L.S.)	London.
Evans, Brigadier W. H. (C.S.I., C.I.E., D.S.O.)	England.
Evershed, John	,,
Ezra, Alwyn (F.R.G.S., F.Z.S.)	Bombay.
Fairweather, J. S. H.	Murree.
Fawcus, L.R. (I.C.S.)	Calcutta.
Featherstone, Gordon B.	
Ferrar, Lt.- Col. M. L. (I.A., O.B.E.)	England.
Field, Major F. D. S. (I.A.)	Udaipur.
Fletcher, Thos. Bainbridge (F.E.S.)	England.
Flockhart, J. J.	Bombay.
Florence, James	Coonoor.
Flynn, A. A. (C.M.Z.S.)	Karachi.
Fooks, H. A.	Calcutta.
Foot, A. E.	Dehra Dun.
Forrington, A.	Bombay.
Foulkes, R.	Madura.
Fountaine, Miss Margaret (F.E.S.)	London.
Fraser, Dr. A. G. (I.M.D.)	Deolali.
Fraser, Duncan	London.
Fraser, Lt.-Col. F. C. (I.M.S., M.D., F.L.E.S.)	Coimbatore.
Fraser, Major S. G. G.	Bombay.
Freke, C. G. (I.C.S.)	,,
Frend, G. V. R.	Kadur.
Garthwaite, P. F. (I.F.S.)	Rangoon.
Gallant, M. N. (B.SC., I.F.S.)	London.
Garbett, Sir C. C. (K.C.E., C.M.G., F.R.G.S., I.C.S.)	Lahore.
Gaye, W.C.	England.
Geddis, A.	Bombay.
Gee, E. P.	Badlipar.
Ghosh, S. K. (I.C.S.)	Rangamatti.
George, Hugh S. (I.F.S.)	Hoshangabad.

Gibbon, Herbert	Vandiperiyar.
Gibbons, J. M. B.	Bombay.
Gibson, E. C. (I.C.S.)	England.
Gilbert, C. E. L. (I.F.S.)	Poona.
Gill, E. H. N. (F.Z.S.)	Sitapur.
Gill, H. A. C.	Kulu.
Gimson, C. (I.C.S.)	Imphal.
Gladstone, Capt. H. S. (F.Z.S., F.R.S.E.)	Scotland.
Gladstone-Solomon, Capt. W. E. (I.E.S.)	Bombay.
Glennie, Major E. A. (D.S.O., R.E.)	Mussoorie.
Goldie, Dr. E. A. (M.C., I.M.S.)	Lahoal, Assam.
Goord, T. D.	Baghdad.
Gordon, F. W. (M.C., M.A. (OXON) I.F.S.)	Scotland.
Gordon, Major J. W.	Jodhpur.
Gorringe, Capt. W. P. H.	Bombay.
Gough, Major W.	Ahmednagar.
Gould, B. J. (C.I.E., I.C.S.)	Bombay.
Gouldsbury, C. P.	Mattupatti.
Gove, Capt. R. V.	Bombay.
Government Departments—	
Director of Agriculture, Bombay	Poona.
Director, Bureau of Science	Manila.
Director of Agriculture, B. & O.	Sabour.
Director of Agriculture in C. P.	Nagpur.
Director of Agriculture, Punjab	Lahore.
Gow, Cedric J.	Kuala Lumpur.
Graham, A. A.	Dehra Dun.
Grant, F. A.	London.
Gravely, Dr. F. H.	Madras.
Gray, James	Devicolam.
Greaves, Mrs. D. J.	Bombay.
Greaves, J. B.	,,
Green, E. Ernest (F.E.S.)	England.
Green, M. M.	Ardmore, U.S.A.
Gregson, T. S.	Bombay.
Grier, J. A. B.	Sholapur.
Gwalior, The Director of State Gardens	Gwalior.
Hackney, M. J.	Bombay.
Hall, J. E	Mozufferpore.
Halliday, Robert S. (I.C.S.)	Hubli.
Hamber, Major L. G. W.	Dharmasala Cantt.
Hambly, R. L.	Calcutta.
Hamid Khan, M. (M.SC., LLB.)	Lyallpur.
Hamilton, Major C. S. P. (D.S.O., M.R.C.S.)	Juri.
Hance, Lt.-Col. J. B. (O.B.E., I.M.S.)	Rajkot.
Hancock, Major C. P.	Bharatpur.
Hanhart, S.	Bombay.
Hardie, J. H.	,,
Hare, Brigadier G. A. (R.A.)	Simla.
Harford, Capt. C.	,,
Harman, A. C.	Bettiah.
Harper, Lt.-Col. A. Forrest	London.

Harper, William	Lahore.
Harrison, Mrs. H. Z.	Bombay
Hartnoll, E. S. (I.F.S.)	Henzada.
Harvey, Major C. W. L. (M.C.)	England.
Hasted, Capt. J. S. H.	Malakand
Haswell, Capt. F. W. (I.A.)	Mawlaik.
Hate, Prof. Vinayakrao N. (B.SC.)	Bombay.
Hawes, C. G.	Karachi.
Hay, D. J.	Barnagaon
Hay, Major R. (I.M.S.)	Quetta.
Heaney, Capt. G. F. (R.E.)	England.
Hearsey, Capt. L. D. W. (M.C., V.D.)	Kheri.
Henderson, L. S.	Tinnevelly
Hennessy, Lt.-Col. J. M. R. (I.M.S.)	Jubbulpore.
Henry, H. A.	Bombay.
Hewetson, C. E. (I.F.S.)	Chanda.
Hewitt, Walter A.	Samastipur
Hickie, Major F. C. (I.A., S.C.)	Poona.
Hickin, S. B.	Sukkur.
Higginbottom, Dr. Sam	Allahabad.
Higgins, J. C. (I.C.S.)	Gauhati.
Hiley, A. C. (I.F.S.)	Poona.
Hill, D. G. (F.R.G.S., J.P.)	Bombay.
Hill, K. A. L. (I.C.S.)	Calcutta.
Hillyer, R. A. N.	Siam.
Hingston, Major R. W. G. (I.M.S.)	London.
Hislop, Lt.-Col. J. H. (M.C., I.M.S.)	,,
Holmes, H. R.	England.
Hopkinson, A. J. (I.C.S.)	,,
Hora, Dr. Sunder Lal (D.SC.)	Calcutta.
Horner, Capt. B. Stuart	London.
Horst, W. (I.S.E.)	Bhimnagar.
Hoshang, N. E. Dinshaw	Karachi.
Howard-Bradshaw, Comdt. C. T. (R.N.)	England.
Howe, P. A. W.	,,
Howell, Sir Evelyn (K.C.I.E., C.I.E., I.C.S.)	London.
Howitt, Capt. J. F. G.	Ferozepore.
Hubback, Theodore R.	Pahang.
Hubbard, Alex E.	Asansol.
Humphrey, J.	Bombay.
Humphrys, A. F. W.	Karachi.
Hurst, L. E. Clifford	Calcutta.
Hutton, C. J.	Lallaguda, Dn
Hyderabad Dn., Inspector-General of Forests	Hyderabad.
Imperial Council of Agricultural Research	New Delhi.
Inder, R. W. (I.F.S.)	Nasik.
Inglis, C. C.	Poona.
Irvine, N. G.	Bombay.
Irwin, Major H. R. (I.A.S.C.)	,,
Isaacs, Miss Mozelle (M.A., M.SC.)	Dombivli
Ishwardas Lakhmidas	Bombay.
Jackson, Dr. T. S.	,,

Jacob, M. C. (I.F.S.)	Gauhati.
James, Lt.-Col. F. H.	Bombay.
Jamesetji, M. Doctor (F.Z.S., C.M.Z.S.)	,,
Jaunpur, Raja Sri Krishna Dutt Dube	Jaunpur.
Jayakar, M. R. (B.A., LL.B.)	Bombay.
Jephson, Major M. D.	,,
Jenkin, R. Trevor (I.F.S.)	England.
Jermyn, Capt. R. O.	Secunderabad, Dn.
Jhalawar, H. H. The Maharaj Rana Rajendra Singh Bahadur	Jhalrapatan.
John, A. W.	Ellapatti.
Johnson, Kay	Moran.
Jones, A. E.	Simla.
Jones, A. J. (I.P.)	Rangoon.
Jourdain, Rev. F. C. R.	England.
Jubbal, Rajkumar Digvijaichand, Heir Apparent of	Jubbal.
Junagadh, His Highness the Nawab of	Junagadh.
Junagadh, The Dewan of	,,
Kanga, Miss P. M. (M.Sc.)	Bombay.
Karachi, Victoria Museum, The Curator	Karachi.
Karve, Janarden Nilkanth	Poona.
Katrak, M. N.	Bandra.
Kazi, E. D. (J. P.)	Bombay.
Keating, H. A.	Kurseong.
Keays, Lt.-Col. R. W. C. (I.A.)	Madras.
Kefford, H. K.	Ajmer.
Kemp, W. N. R.	Peeprah.
Kempe, Hon'ble Mr. J. E.	Klang.
Kemson, M.	Europe.
Kermode, C. W. D. (I.F.S.)	London.
Kerr, Ewen F.	Calcutta.
Kerr, F. S.	Bombay.
Khan, Sahebzada Sardar Mahomed	Ratnagiri.
Khanolkar, Dr. Vasanat R. (B.Sc., M.D.)	Bombay.
Khareghat, M. P. (I.C.S.)	,,
Kiernander, Major O. G.	England.
Kilburne, R. G.	Nepal.
King, E. O. (I.A.R.O.)	Kodaikanal.
Kinloch, Mrs. A. M.	Kotagiri.
Kirwan, Noel G. B.	Mangalore.
Knight, H. F. (I.C.S.)	Bombay.
Koechlin, E. L	Nilgiris.
Kohli, P. N.	Lahore.
Kothavala, T. T.	Surat.
Krishnalal, Rai Bahadur Capt. (D.R.T.C., M.I.E. & S., A.F.R.A.S.)	Indore.
Krishnan, E. K.	
Kuroda, Dr. Nagamichi	Tokyo.
Laidlay, J. C.	Scotland.
Laljee, Hooseinbhoy A.	Bombay.
Lamb, Thos.	Calcutta.
Landells, W. J.	Monywa.

Langdale, A. H.	Bombay.
Langdale-Smith, W. K.	Bungli-Rungliot.
Lastic, D. A. de	
Latham, H. D.	Vellore.
Latif, Sarhan C.	Karachi.
Laud, D. S.	Bombay.
Laurie, M. V. (I.F.S.)	Ootacamund.
Lawther, B. C. A. (C.I.E.)	Peshawar.
Leach, Hon'ble Mr. Justice A. H. L.	Rangoon.
Lees, L. M. (I.C.S.)	,,
Leland, A. G.	Java.
LeMarchand, A. E. M.	England.
LeMarchand, W. M.	Dibrugarh.
Levett, R. W.	Coimbatore.
Lewis, E. S.	Lyallpur.
LIBRARIES—	
Allahabad Public Library, The Secretary	Allahabad.
Annamalai University Library	Annamalai.
Hyderabad, The State Library	Hyderabad, Dn.
Imperial Library, The	Calcutta.
Lahore, University of Punjab, The Librarian	Lahore.
Lytton Library, Muslim University	Aligarh.
Madras, Connemara Public Library, The Principal Librarian	Madras.
Nilgiri Library, The Honorary Secretary	Ootacamund.
Public Library, Museums and National Gallery of Victoria, The Chief Librarian	Melbourne.
Public Library, Museum and Art Gallery, Adelaide.	S. Australia.
United Service Library, The Honorary Secretary	Poona.
Lightfoot, Capt. G. S. (I.P.)	Jorhat.
Lightfoot, S. St. C.	Taunggyi.
Limbdi, H. H. Maharana Shri Sir Daulatsinhjee (K.C.I.E.) of	Limbdi.
Lindsay-Smith, Capt. J.	Quetta.
Lister, R. S.	Ghoom, Bengal.
Little, E. (I.S.O.)	Kirkee, Poona.
Locket, A.	Numaligarh.
Lodge, G. E.	England.
Logan-Home, Lt.-Col. W. M.	Secunderabad, Dn.
Longstaff, C. C.	Bombay.
Lowman, Capt. Stephen (I.A.S.C.)	Ahmednagar.
Lowndes, R. C.	Bombay.
Lowsley, C. O.	England.
Lowther, E. H. N. (F.Z.S., M.B.O.U.)	Dhanbad.
Lucknow, Provincial Museum, The Curator	Lucknow.
Lushington, Mrs. C. G.	Ceylon.
Lutyens, F. M. B.	Calcutta.
MacColl, H. H. (I.E.S.)	London.
MacDonald, A. St. J.	Darbhanga.
MacDonald, R.	Chubwa.
Macdonell, J. F.	Bombay.
MacGregor, Lt.-Col. R. F. D. (I.M.S.)	,,

MacGusty, H. M.	Bombay.
Mackenzie, J. M.	Calcutta.
Mackenzie, T. J.	Indore.
Mackenzie, Wm.	Udamalpet.
Mackie, A. W. W. (c.i.e., I.C.S.)	Poona.
Mackwood, F. E.	Colombo.
MacLachlan, D. (I.C.S.)	Poona.
MacLachlan, R. B. (C.I.E.)	Karachi.
Macleod, A. (I.C.S.)	England.
Macleod, Capt. A. J. W.	Waziristan.
MacMichael, N. (c.s.i., I.C.S.)	Scotland.
Macnaghten, Sir Henry (*Kt.*)	England.
Macnaught, W. E.	Perak.
Maconachie, Sir Richard (*Kt.*, c.i.e.)	Kabul.
Madan, F. R. (i.f.s.)	Ootacamund.
Madras, H. E. the Governor of	Madras.
Mahendra, B. C. (m.sc.)	Agra.
Mahon, Col. A. E.	Kulu.
Major, R. A. M.	Saharanpur.
Maltby, Lt.-Col. C. M. (i.a., m.c.)	Simla.
Mankapur Raj, Raja Ambikeshwar Pratap Singh Saheb (m.l.c.)	Mankapur.
Marjoribanks, Sir Norman (k.c.i.e., c.s.i., I.C.S.)	Madras.
Marr, Mrs. F. A	Digboi.
Marshall, Maj.-Genl. F. J. (c.b., c.m.g., d.s.o.)	England.
Marshall, George H. L.	Calcutta.
Marshall, Mrs. H. A.	Travancore.
Martin, C. H.	Bombay.
Martin, S. J.	London.
Martin-Leak, Col. A. (v.c., v.d.)	Calcutta.
Matthews, W. H.	Rungli-Rungliot.
Maxwell, R. M (I.C.S., c.i.e.)	Bombay.
McGlashan, John (c.i.e.)	England.
McLeod, Brigadier D. K.	Risalpur.
McMahon Museum, The Honorary Secretary	Quetta.
Mears, C. E. D	Indore.
Mehta, Sir Hormasji, *Kt.*	Bombay.
Mehta, Jamshed N. R.	Karachi.
Mehta, K. M.	Bhavnagar.
Meinertzhagen, Lt.-Col. R.	London.
Menezes, J. Hector	Goa.
Milbank, M. V.	Bombay.
Milburne, W.	Barjuli.
Mills, J. P. (I.C.S.)	Calcutta.
Milner, C. E.	London.
Minchin, A. A. F. (i.f.s.)	
Mirchandani, U. M. (I.C.S)	Thana.
Mistri, Dr. J. D.	Bombay.
Mitchell, Miss D.	,,
Mitchell, Leonard	England.
Mohr, Dr. V. der Meer	Medan, Sumatra.
Moller, Ft.-Lt. C. Wm. Hy.	Lahore.

Moloney, William J.	Bombay.
Monteath, J. (I.C.S.)	Junagadh.
Montmorency, Sir Geoffrey de (K.C.V.O., K.C.I.E., C.B.E., I.C.S.)	England.
Mooney, H. F. (I.F.S.)	Ranchi.
Moore, Major A.C. (I.A.)	Palani.
Moore, G. D.	Bombay.
Moore, John	London.
Moos, A. N.	Bombay.
Morden, William J.	U. S. A.
Morehead, F. T. (O.B.E., B.SC., I.F.S.)	Rangoon.
Morgan, R. W. D.	Calcutta.
Morgan, Vernon	Agra.
Morrison, Lt.-Col. John (I.M.S.)	London.
Morris, Chas. W. G.	Attikan.
Morris, R. C. (F.Z.S., F.R.G.S.)	,,
Morton, Geo. B.	Calcutta.
Mott, John L.	New York City
Mudhol, Shrimant Sir Malojirao Raje Ghorpade (K.C.I.E.) of	Mudhol.
Mueller, Dr. Herbert C. (D.SC.)	Bombay.
Mullen, G. R.	
Mulroney, J. T.	Kurseong.
Mundy, N. S.	Silchar.
Murphy, P. J.	Ramna, Dacca
Musgrave-Hanna, Capt J. R.	Jhelum.
Muzumdar, Shanker Vamanrao, (C.A.I.B. (Eng.), F.R. ECONS. S.)	Bombay.
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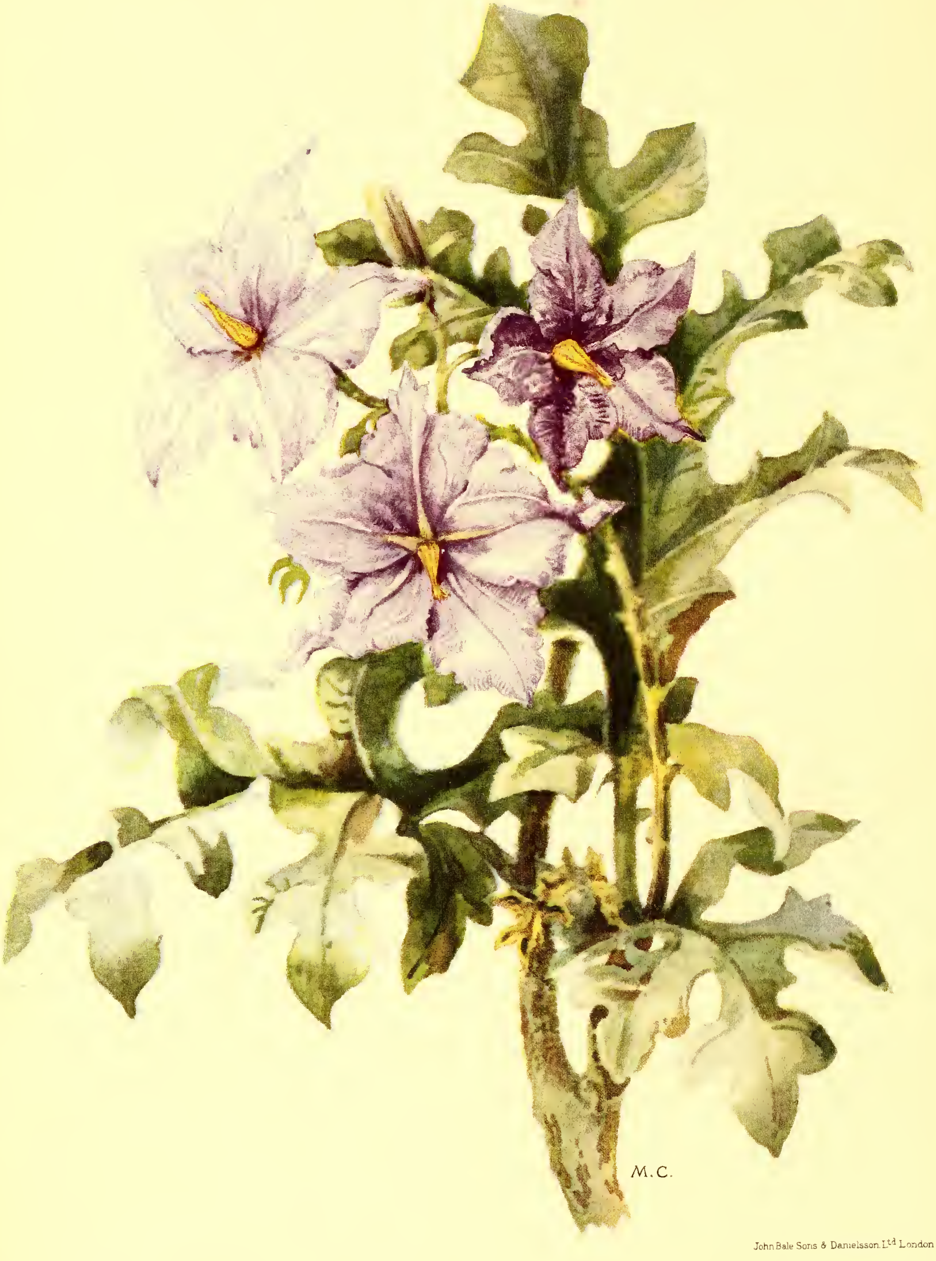

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LARGE-FLOWERED NIGHTSHADE OR POTATO TREE.

Solanum macranthum, Dun.

(about ¾ nat. size)

GAME BIRDS OF THE INDIAN EMPIRE.

Mr. Stuart Baker's serial on the Waders and other Semi-Sporting Birds will be concluded in the next Number.—Eds.

JOURNAL
OF THE
Bombay Natural History Society.

DECEMBER, 1934. VOL. XXXVII. No. 3.

SOME BEAUTIFUL INDIAN TREES.

BY

THE LATE E. BLATTER, S.J., Ph.D., F.L.S.,
and W. S. MILLARD, F.Z.S.

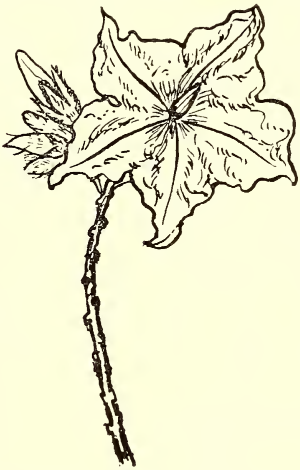
PART XVI.

(*With one coloured and one black-and-white plates and 2 text-figures*).

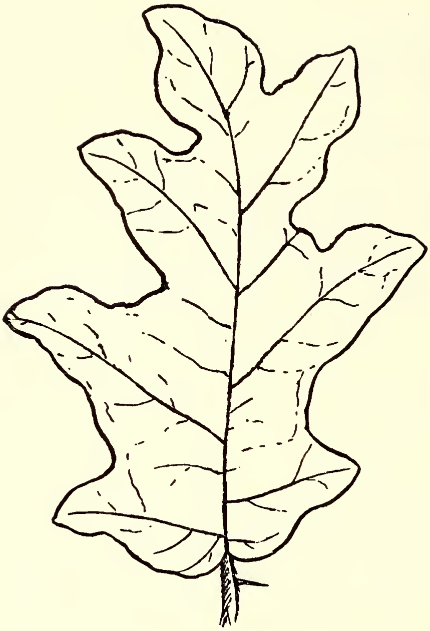
(*Continued from page 313 of this volume*).

THE LARGE-LEAFED NIGHT SHADE OR POTATO TREE.

Solanum macranthum Dun.—Belongs to the family *Solanaceae* of which the Potato is the best known representative. *Solanum* is from the Latin *Solatium* = Solace, because of the sedative properties which its several species exercise to lull pain. *Macranthum* from the Greek *makros* = large and *anthos* = flower, in reference to the size of the flowers.



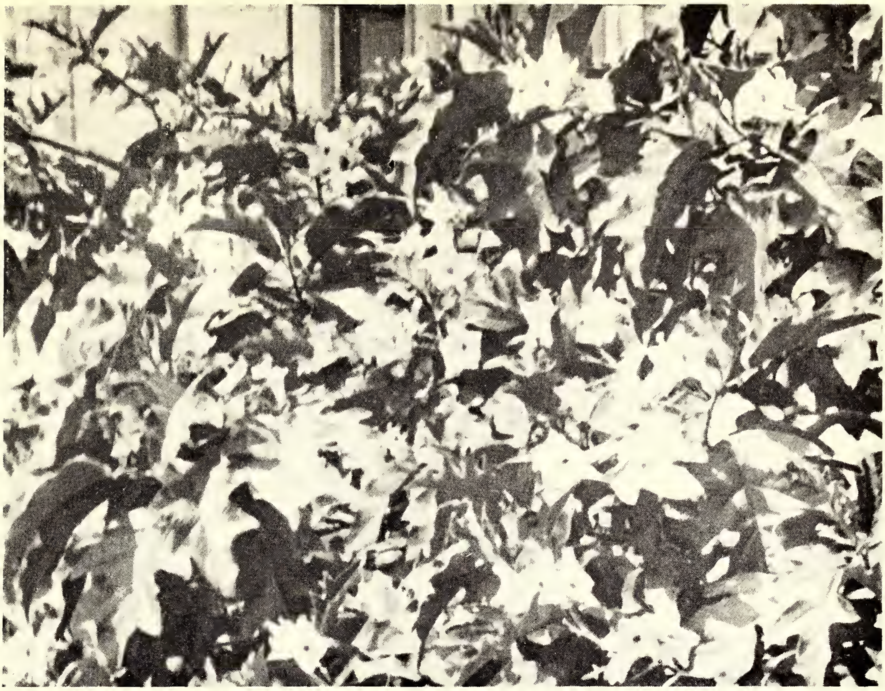
Description: A shrub or small tree occasionally reaching a height of 30-40 ft. with yellowish brown straight prickles. Leaves large 10-15 in. long sometimes narrowing at the base forming a winged leafstalk. The leaf is slightly heart-shaped, egg-shaped, lance-shaped, or elliptically lance-shaped with deeply cut angles or lobes. It is paler beneath, covered with fine star-like hairs. The young leaves and shoots are densely covered with the same covering. The leaves on the undersurface are strongly armed with long prickles arranged at intervals along the nerves. The flowers are arranged in simple or branched bunches 3-5 in. long from 7-12 in number. The corolla is bluish-violet, 1½-2½ in. in diameter, the lobes are sharply pointed. The anthers are large and yellow. The fruit is almost rounded, the size of a golf ball.



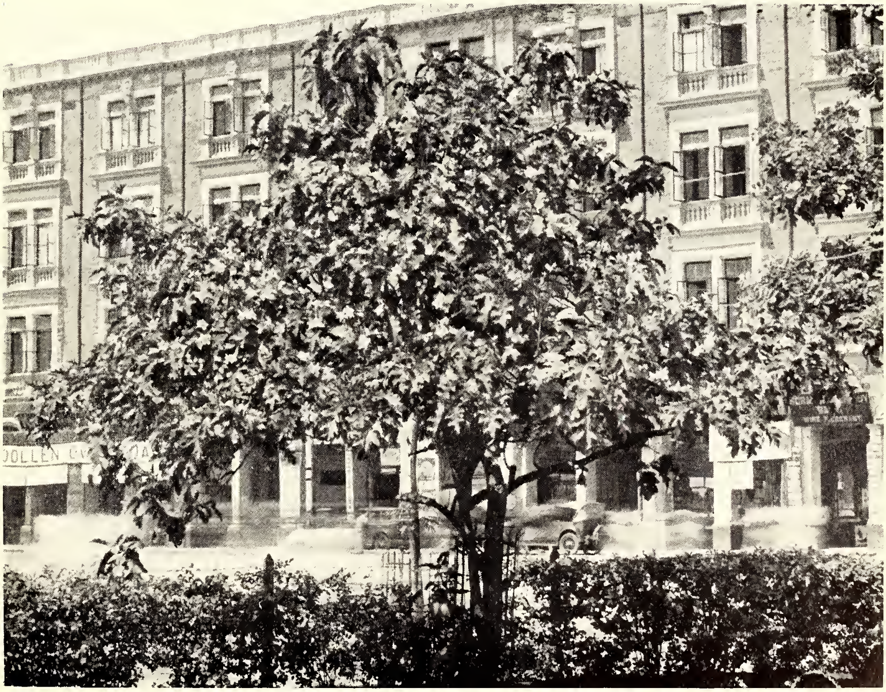
Distribution: The Potato Tree is a native of Brazil.

Gardening: This plant is widely cultivated in gardens for its large showy flowers and beautiful leaves. It flowers the year round. It is easily propagated from seed or cuttings. Thrives best in sheltered and partially shaded situations, up to 3,000 ft. or higher if not exposed to strong winds. It was first introduced into Ceylon in 1844. This is probably the only species of the potato family that attains the form of a tree.

(*To be continued*).



Flowers of the Large-flowered Nightshade or Potato Tree,
(*Solanum macranthum*, Dun.).



Photos by *H. N. Wandrekar.*

The Large-flowered Nightshade or Potato Tree,
(*Solanum macranthum*, Dun.).

THE VERNAY SCIENTIFIC SURVEY OF THE EASTERN GHATS.

(Ornithological Section).

BY

Hugh Whistler, M.B.O.U., assisted by N. B. Kinnear, M.B.O.U.

Part IX.[1]

(*Continued from page 297 of this volume*).

Thereiceryx zeylanicus zeylanicus (Gmel.).

Bucco zeylanicus Gmelin, Syst. Nat., vol. i, part. i (1788), p. 408—Ceylon.

The typical race of the Common Green Barbet extends to Travancore, where according to Ferguson, it is uncommon in the low country. He mentions shooting one as high as 4,000 ft.

According to Stuart Baker (Nidification, vol. iii, p. 326) Stewart took two nests in the extreme south of Travancore on 7th March.

Thereiceryx zeylanicus inornatus (Walden).

Megalaima inornata Walden, Ann. Mag. Nat. Hist., ser. 4, vol. v (March 1870), p. 219—Malabar (Coorg).

The account of the distribution of this race of the Common Green Barbet in the *New Fauna* (vol. iii, p. 111) is not at all easy to understand and there appears to be very little accurate information about its distribution in the Presidency where it is perhaps confined to the Western side. The British Museum contains the following specimens:—♂ 9 September 1882 Cannanore (Wardlaw-Ramsay); three birds 'Malabar' (Tweeddale Collection); two birds, including the type, Coorg (Waldan). It is said to breed in the Nilgiris in March (Rhodes Morgan), and according to Stuart Baker (Nidification, iii, p. 328) the eggs were obtained in the Nilgiris in April by both Col. H. R. Baker and General Betham. I have not, however, seen any skins from these hills and the species is not included by William Davison in his list of Nilgiri birds. There also seems to be no evidence for the statement (*New Fauna*, iv, p. 111) that this race occurs in Northern Travancore.

Thereiceryx zeylanicus caniceps (Franklin).

Bucco caniceps Franklin, P.Z.S. 1830-31 (October 25, 1831), p. 31—Between Calcutta and Benares and in the Vindhyan Hills between the latter place and Gurra Mundela.

Specimens collected:—1369 ♂ 10-2-30 Anantagiri 3,000 ft.; 1554 ♀ 16-3-30 Sankrametta 3,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
1 ♂	30·5	114·5	67·5	26 mm.
1 ♀	33	119	70·5	29 mm.

Franklin's race of the Common Green Barbet is recorded by Jerdon at Goomsoor and at Jeypore by Ball. A male collected by the latter on 23 March

---

[1] It is perhaps advisable to remark that this is the first part of the Eastern Ghats Survey to include the records from Mr. Stuart Baker's *Nidification of Birds of the Indian Empire*. The previous parts were written before the publication of the relevant volumes of Mr. Stuart Baker's book.

1877 is in the British Museum. The above two survey specimens and a male in the British Museum, collected by Blanford north-east of Rajamundry on 29 May 1871 complete the records from this area.

Whether it occurs or not in the southern half of the east of the Presidency needs confirmation, both as to race and species. Roscoe Allen (J.B.N.H.S., xviii, p. 906) states that it breeds at Horsleykonda. Dewar says that he never saw or heard it personally at Madras, but that he had had it described to him. There is said to be a specimen in the Madras Museum, collected at Udayagiri.

The survey specimens agree with others from neighbouring areas in being small compared with birds from the Western Himalayas, though they agree with them in colour. Five males (Allahabad, Orissa, Vizagapatam, Hyderabad) measure:—bill 30·5-34, wing 112-117·5, tail 67-76 mm. Seven males from the Western Himalayas (Kangra to Gahrwal) measure:—bill 34-36·5, wing 121·5-129·5, tail 79·5-81 mm. The smaller bird is clearly Franklin's *Bucco caniceps* and I therefore propose for the other the name:—

Thereiceryx zeylanicus kangrae subsp. nov.

Type:—♂ Ranital 2,000 ft., Kangra 11 December 1921. Coll. H. Whistler No. 4042. British Museum register No. 1934.10.17.1.

Thereiceryx viridis Boddaert.

Bucco viridis Boddaert, Table Pl. Enlum. (1783), p. 53, based on Pl. Enlum. 870—India (Mahé).

Specimens collected:—204 ♀ 11-5-29, 240-241 ♀♀ 17-5-29 Shevaroy Hills 3,500-4,500 ft.; 383-384 ♂♀ 11-6-29 Chitteri range 3,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
1 ♂	25·5	102	66	26 mm.
4 ♀	25-27·5	102-109	61-67·5	25-27·5

La Personne reports that the Small Green Barbet was remarkably common and noisy on the Shevaroys, and in smaller numbers on the plains below. In the Shevaroys there seemed to be one in every tree. From the state of the organs it appears that the breeding season was well advanced in May.

This is an extension of the recorded range of this barbet which has hitherto been considered as confined to the West Coast. The *New Fauna* (iv, 114) gives its northern limit as Mahableshwar and the Deccan but Hayes Lloyd (S.F., i, 419) says that he obtained it in the Peint and Soorungun districts which border on the Khandeish Dangs, and James Davidson thought that he had seen it once or twice in the Satpuras (S.F., x, 298).

On the western side of the Presidency it is very common and well known. A specimen in the Hume collection was obtained at Mangalore and there are 4 specimens from Cannanore in the Wardlaw-Ramsay collection. Darling met it at Calicut (N. & E., ii, p. 326) and a specimen in Colonel Sparrow's collection was collected at Malappuram. In Coorg, the Wynaad and the Nilgiris, the Nelliampathies and Palnis and throughout Travancore it is extremely common at all elevations and there is no need to cite the records.

The breeding season in the Nilgiris, according to William Davison and Darling, extends from March until the first or second week of June; and those dates cover the records in the rest of our area except that Kinloch is said to have taken eggs in February in the Nelliampathies.

This Barbet undoubtedly increases in size from south to north. Of 8 specimens measured from Travancore, the largest has a wing of 104 mm., and all but three have wings under 100 mm. Ten specimens from Matheran, Khandala and Khandesh measure from 103 to 113 mm., specimens from other areas, however, obscure this distinction and at present I do not see any point in recognising two races.

Xantholaema haemacephala indica (Latham).

Bucco indicus Latham, Index Orn., vol. i (1790), p. 205—India.

Specimens collected:—466 ♂ 23-6-29 Tirthamalai 1,000 ft.; 506 ♀ 4-7-29

Kalai; 714 ♀ 719 ♀ 20-8-29 Palkonda Hills; 752 ♂ 1-9-29, 803 ♀ 11-9-29 Kodur; 909-910 ♂ ♀ 12-10-29 Seschachalam Hills 2,000 ft.; 1164 ♂ 23-12-29 Cumbum Valley; 1343 ♂ 6-2-30, 1419 ♂ 21-2-30, 1761-1764 ♀ juv. ♂ ♀ ♂ 3-5-30 Anantagiri 3,000 ft.; 1726 ♂ 24-4-30, 1729 ♂ 26-4-30 Jeypore agency 2,000 ft.

Measurements :—

	Bill.	Wing.	Tail.	Tarsus.
10 ♂	17-18·5	77-83·5	34-36	17-19·5 mm.
6 ♀	17-19	74-81	33-35	17·5-19 mm.

The Crimson-breasted Barbet was found very commonly throughout the hill-tracts of Vizagapatam, as the list of specimens implies. Although there is no other record between that area and the Godavery Valley it is probably safe to assume that this species is a common resident throughout the whole of the eastern side of the Presidency. Dewar remarks on how he sometimes saw 70 or 80 birds collected in a single tree at Madras.

On the west it is very common in Coorg (Betts). It is sparingly distributed through the Wynaad and about the base of the Nilgiris (William Davison). I have seen specimens from the Segore and Kotagherry Ghats and Coonoor and these were probably all collected at low elevations. I have seen other specimens from Calicut (2 Hume collection), Pothanore (Hume collection) and Malappuram (Hume collection). In the Nelliampathies, according to Kinloch it does not occur. In the Palnis, Fairbank found it common at the base and up to 4,000 ft. In Travancore, it is said to be very common throughout the low country and at times on the hills up to 1,500 ft.

In the Vizagapatam hills, La Personne states that these Barbets were feeding young in the last week of April. In Travancore, they are said to lay in March.

In the *Ibis* 1919, pp. 219-22, Mr. Stuart Baker decided that there was only the one race of this Barbet in India, Ceylon and Burma but in the *New Fauna*, vol. iv, pp. 127-9, he changed his mind and recognised two races differing only in depth of colouration. The former opinion was right. The variation in tone and depth of colour in this species is partly individual but more largely due to the extent of wear. The survey series from Vizagapatam are in worn plumage and at first examination appeared to stand out markedly from the series obtained from south of the River Godavery as being olive greyish-green on the upper parts, very distinct from the more usual golden green colour of the worn plumage. I have, however, been able to match the Vizagapatam birds with others from the Nilgiris. Ceylon birds do not differ in size or colour from those of the main land.

Xantholaema rubricapilla malabarica (Blyth).

Bucco malabarica Blyth, J.A.S.B., vol. xvi (1847), pp. 386, 465—Malabar.

Not obtained by the Survey. The Crimson-throated Barbet is confined to the western coast of India from the Goa Frontier (Fairbank) to the south of Travancore. There is some doubt about its northern boundary. Fairbank recorded it from the Savantvadi Forests (S.F., iv, 255), but doubt was later thrown on the record (S.F., x, 423). Major Lloyd also included it as a Konkan species, but this was in turn doubted by Butler (S.F., ix, 387).

In the Presidency, William Davison says that it seems to be spread through the Wynaad and in some parts, as near Manantoddy, is comparatively common. There are specimens from Goodalore and Nellacotta in the Hume collection and there are 3 specimens collected by Wardlaw-Ramsay at Tellicherry in the Tweeddale collection.[1] It is very common in the Nelliampathies (Kinloch). In Tarvancore it is a rare forest bird in the hills, according to Ferguson, and he states that Bourdillon's account (S.F., iv, 392) is based on confusion with *X. haemacephala.* This fact must throw suspicion on the identity of the eggs collected by Bourdillon and described in N. & E., 2nd ed., vol. ii, p. 332 and mentioned by Stuart Baker (Nidification, vol. iii, p. 340).

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[1] I cannot trace the locality Chawachiraj from which there are six specimens in the British Museum collected by Wardlaw-Ramsay.

The breeding season is in February and March according to the *New Fauna*, vol. iv, p. 130.

The Crimson-throated Barbet must in my opinion be considered a race of the Small Ceylon Barbet (*Xantholaema rubricapilla*). The latter differs from the former merely in having the supercilium, cheek, patch, chin and throat yellow instead of red, while the red patch on the lower throat is reduced in size. The relationship between red and yellow is well-known and the close connection between the two forms is shown in the juvenile plumage. The young of the two forms are not distinguishable, the traces of the red or yellow patches of the adult being yellow in both juveniles. A specimen of *X. haemacephala indica* in Col. Sparrow's collection from Muttra has the red of the head and breast replaced by yellow with slight traces of a red wash.

Cuculus canorus Linnaeus.

Cuculus canorus Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 110—Europe restricted to Sweden.

There is very little information about the Common Cuckoo in the Presidency though it evidently occurs. In Jaipur, Ball tells us (S.F., v, p. 414) that he not unfrequently heard a cuckoo in April which from its note must have been this species. La Personne says that in the Vizagapatam district in April it was calling and that it probably breeds at Sankrametta, but unfortunately none was obtained. Roscoe Allen heard it at Hosleykonda on 29 May (J.B.N.H.S., xviii, 905).

There is a specimen in the Government Museum at Madras which was killed in the neighbourhood though, according to Dewar, it only occurs on very rare occasions.

On the western side, Ferguson says that a specimen was shot at Trivandrum in February 1893. This bird has been obtained on two or three occasions in Ceylon.

As I have examined no specimen from the Presidency I am unable to discuss the question of the race which occurs.

[**Cuculus optatus** Gould.

Cuculus optatus Gould, P.Z.S. April 1845, p. 18—Port Essington, Northern Territory.

William Davison (S.F., x, 359) stated that the Himalayan Cuckoo was sparingly distributed in the Wynaad and that he had heard it calling late in May. This record has however been discredited by Blanford (P.Z.S. 1893, p. 318).]

Cuculus poliocephalus poliocephalus Latham.

Cuculus poliocephalus Latham, Index Orn., vol. i (1790), p. 214—India.

Specimen collected:—925 o? juv. 17-10-29 Seschachalam Hills 2,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
Sex? juv.	24.5	149	126	17 mm.

The Small Cuckoo is a winter visitor or passage migrant to the Presidency but we have very little definite information about it. On the eastern side Jerdon states that he procured it at Nellore (B. of I., i, 325) and the survey specimen provides the second specimen.

On the west the only records are furnished by a juvenile in the Society's collection obtained at Mercara, Coorg, on 20 October 1918 and a male in the British Museum, collected by Wardlaw-Ramsay at Cannanore on 7 September 1882.

It is commonly said to occur in the Nilgiris but I have not traced any evidence of the fact.

The fact that it is a passage migrant in large numbers through Dhulia (James Davidson, S.F., x, 299) from the middle of September to the middle of October suggests that it must be more numerous in the Presidency than the actual records indicate.

Cuculus micropterus Gould.

Cuculus micropterus Gould, P.Z.S. December 5, 1837, p. 137—Himalayas, Simla.

Not met by the Survey. Very little is known about the Indian Cuckoo in the Presidency. Jerdon states (B. of I., vol. i, p. 327) that he had found it rare on the Malabar Coast and in the Carnatic. This tells us little and there is no more definite record for the eastern side, though two specimens in the Madras Museum are said to have been obtained locally. On the west William Davison says he found it occasionally in the Wynaad. There is a male in the Hume collection obtained at Coonoor on 28 July 1867. In Travancore Ferguson says that he never met with it in the hills but that it frequents forest in the low country and that its cry may be heard in April and May, especially towards dusk. The Trivandrum Museum then contained two specimens, shot in February and May. According to Stuart Baker (Nidification, iii, p. 347) an oviduct egg was obtained by Stewart in Travancore.

This southern bird appears to be identical with the Himalayan form, but there is not sufficient material to allow of a final decision on the point.

Hierococcyx sparverioides (Vigors).

Cuculus sparverioides Vigors in Gould Cent. Birds Himalayas 1831, plate 53—Himalayas.

The Large Hawk-Cuckoo has only been recorded from the Nilgiris so far as the Madras Presidency is concerned. There according to William Davison it frequents the Sholas and occasionally also well-wooded gardens. There are three specimens in the Hume collection viz., an unsexed and undated bird from Coonoor, a male dated 12 February 1881 from Ootacamund (Davison) and a female from Kotagherry collected by Miss Cockburn on 7 December 1874.

Its status in the Nilgiris is not very clear. Miss Cockburn communicated a long description to Hume (N. & E., vol. ii, p. 384) of two supposed nests found on April 11 and May 21 but these nests had evidently nothing to do with Hawk-Cuckoos though one was shot near the first of them.

Davison and Hume considered that these Nilgiri birds were smaller than the Himalayan breeding form but I have examined equally small birds from the Himalayas and can find no means of separating birds from the two areas.

Hierococcyx varius Vahl.

Hierococcyx varius Vahl, Skriv. Nat. Selsk. Kjöbenhavn, vol. iv (1797), pt. i, p. 61—Tranquebar, India.

Specimens collected:—78 ♀ 18-4-29, 143 ♂ 27-4-29 Kurumbapatti; 273 ♂ 23-5-29 Shevaroy Hills 4,000 ft.; 1039 ♂ imm. 25-11-29 Nallamalai range 2,500 ft.; 1629 ♀ 30-3-30 Sankrametta 3,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
3 ♂	26·5-27·5	190-195·5	162-166	24 mm.
2 ♀	27·5	188-194	152-166	23-24·5 mm.

The Common Hawk-Cuckoo seems to be widely, but by no means generally, distributed in the Presidency. In the extreme north-east Ball met it at Jeypore and La Personne obtained the above specimen at Sankrametta. Further south La Personne obtained it also in the Nallamalai Hills. About Madras it would seem to be scarce, as Dewar remarks that he only heard the well-known call once in eighteen months. In May and June the Survey found the Hawk-Cuckoo common in the Shevaroys and Chitteri Hills. They were calling late into the night and, when the moon was favourable, practically all night. Similarly at Kurumbapatti in April they were found to be common and were heard both by day and night.

On the western side of the Presidency, Betts considers it uncommon in Coorg and remarks that he never heard it calling there. He was of opinion that a young cuckoo which he saw being fed by Magpie-Robins was probably of this species. William Davison found the Hawk-Cuckoo plentiful throughout the Wynaad, and even more so on the slopes of the Nilgiris and on the plateau. There he noticed the nestling being fed by the Nilgiri Laughing-Thrush.

In the Nelliampathies according to Kinloch the bird does not occur. This seems curious as in the Palnis Fairbank found it common both at the base and on the hillsides, while in Travancore it is said to be abundant in the semi-cultivated land of the plains. It occasionally penetrates the jungles about the base of the hills up to about 1,000 ft. but Ferguson says he only met it once as high as 2,000 ft.

There seem to be no records about the breeding of this cuckoo in the Presidency beyond the implications of the above account and Stuart Baker's statement (Nidification, vol. iii, p. 349) that in South-west India most birds breed in May and June and in late April. Its actual status is not very clear though in the Nilgiris it seems to occur in most months. Baker says it is a resident species wherever found and that it is silent, and so not observed, out of the breeding season. Legge, however, says (Birds of Ceylon, p. 241) that it is extremely noisy at all times, even out of the breeding season and in Ceylon he considered it a migrant, arriving about the beginning of November. Wait, however, thinks that a few birds may be resident.

The only two specimens which I have been able to examine from Ceylon appeared to be darker than continental birds.

Cacomantis merulinus passerinus (Vahl).

Cuculus passerinus Vahl, Skriv. Nat. Selsk. Kjöbenhavn, vol. iv, pt. i (1797), p. 57—Tranquebar, India.

Specimens collected:—834 ♂ 19-9-29 Kodur; 936 ♂ 20-10-29 Seschachalam Hills 2,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
2 ♂	22	113	105·5-110	17-17·5 mm.

The Indian Plaintive Cuckoo has not been recorded definitely from that part of the Presidency north of Kodur and the Seschachalam Hills where it was obtained by the Survey. There is no other record from this side beyond an undated female, labelled Madras, in the Hume collection and Jerdon's general statement that it is rare in the Carnatic but found here and there in jungly places, and on the Eastern Ghats.

On the western side it occurs in fair numbers in the Wynaad and on the slopes of the Nilgiris at all elevations. The status here and in other parts of the Presidency is nowhere recorded but it is doubtless a resident in the Nilgiris as Miss Cockburn took a series of eggs from nests of *Prinia inornata* at Kotagherry from 17th to 26th September and found a nestling in a nest of the same foster-species on 5 October (Hume, N. & E., 2nd ed., vol. ii, p. 386). The Hume Collection contains skins from Kotagherry dated May, June and September as well as the above nestling killed on the 14th October. Specimens collected at Coonoor in April and September by Wardlaw-Ramsay are also in the British Museum.

In Travancore it appears to be rare. Ferguson only obtained two specimens shot in April in forest in the low country.

In the *New Fauna*, vol. iv, p. 155, Western Nepal is given as the western limit in the Himalayas. This is incorrect. It is comparatively common as a summer visitor to Simla (J.B.N.H.S., xxxii, 727) and it occurs in smaller numbers at Dharmsla (Ibis 1926, 749), at Murree (Rattray, J.B.N.H.S., xvi, 661) and Abbotabad (Currie, J.B.N.H.S., xxiv, 595). The account of the plumages is also quite misleading.

Cacomantis merulinus querulus Heine.

Cacomantis querulus Heine, Jour. für Orn. 1863, p. 352—Nepal.

Specimen collected:—1177 ♂ 26-12-29 Cumbum Valley.

Measurements:—

Bill.	Wing.	Tail.	Tarsus.
22	111	112·5	17·5 mm.

The above specimen of the Burmese race of the Plaintive Cuckoo not only furnishes the only record for the Presidency but it also extends the range of the race in India. It has not previously been recorded south of Raipur, whence there are two males in the Hume collection dated January 1871 and 13 February 1871. The survey specimen is in adult plumage, except for some traces of the juvenile dress.

Penthoceryx sonneratii sonneratii Latham.

Penthoceryx sonneratii Latham, Index Orn., vol. i (1790), p. 215—India.

Not obtained by the Survey. The Banded Bay Cuckoo occurs in the Presidency in small numbers on the western side. There are specimens in the British Museum from Cannanore (♂ 9-9-82, Wardlaw-Ramsay) and the Wynaad (♂ 22-9-77, Darling) and four others from 'Malabar'. Jerdon and William Davison both say that it occurs on the slopes of the Nilgiris and the British Museum contains a specimen (♀ April 1878, Wardlaw-Ramsay) from Burliar, Coonoor Ghat and another (♂ 8-4-83, Davison) from Coonoor.

In Travancore Jerdon considered it tolerably common but Ferguson, on the other hand, called it decidedly rare.

On the eastern side of the Presidency the only record is Jerdon's statement that it is found more rarely in the Eastern Ghats and Mr. Roscoe Allen's mention of it at Horsleykonda in April (J.B.N.H.S., xviii, p. 905).

This cuckoo is apparently a resident in S.-W. India. In Hume's N. & E. (vol. ii, p. 382), it is stated that a broken egg was taken from the oviduct of a female shot on the Nilgiris on 19 May 1874. The authority for this statement is not given and the colour of the egg, pale bluish green, spotless, is at variance with the type of eggs that Mr. Stuart Baker believes to belong to this species. Other supposed eggs were taken in Coorg on 18th July (see J.B.N.H.S., xvii, 680).

Chalcites xanthorhynchus (Horsfield).

Cuculus xanthorhynchus Horsfield, Trans. Linn. Soc., vol. xiii, pt. 1 (May 1821), p. 179—Java.

Dr. Gravely kindly informs me that there is a male specimen of the Violet Cuckoo in the Madras Museum, collected at Perambur near Madras. This specimen does not appear to have been recorded.

Chalcites maculatus maculatus Gmelin.

Trogon maculatus Gmelin, Syst. Nat., vol. i, pt. i (1788), p. 404—Ceylon.

In Stray Feathers, vol. ix, p. 298, Mr. W. F. Dique records that 'on the 6th March 1878 a lovely male *Chrysococcyx maculatus* was caught with bird-lime in a garden at the Adyar, a few miles to the south of Madras. This specimen has the 'entire breast uniform emerald green'. This record of the Emerald Cuckoo was overlooked by the *New Fauna* and it is of especial interest not only in view of Jerdon's statement that 'it has been procured rarely in Central India', but with reference to the type locality.

Gmelin based his description of *Trogon maculatus* or the Spotted Curucui in the New Illustrations of Zoology of Peter Brown (p. 25, pl. xiii, fig. 2) published in 1776. In his introduction Brown tells us that a number of the 'plates are copied from the elegant Drawings, generously communicated to me by Gideon Loten Esq., and originally furnished under his own inspection from living subjects, during his residence in the Islands of Java and Ceylon of the latter of which he was Governor.' Loten was in the Dutch Colonial Service and held appointments in Java and Ceylon, in which latter place he served as Governor from 1752-57, and his original plates are in the British Museum. Seventeen of Loten's plates were used by Brown. Three of these are of Javan birds as stated by Brown and marked by Loten on the originals. Thirteen others are said by both Loten and Brown to represent birds from Ceylon. Of these ten can be identified for certain with species found in that island. Two others can only be doubtfully identified and a third (pl. xxxviii) called by Brown a Rail cannot be identified with any known species and Loten's original drawing does not help in any way. The remaining plate is of the Spotted Curucui which is also stated by Brown to have come from Ceylon, but the original is missing so that we have no means of ascertaining what Loten actually said about the bird. This fact and the belief that the Emerald Cuckoo could not possibly occur in Ceylon has thrown doubt on Brown's type locality and an endeavour has been made to reject it. This in our opinion is unnecessary in view of the Madras record, for cuckoos are noted wanderers.

Surniculus lugubris lugubris (Horsfield).

Cuculus lugubris Horsfield, Trans. Linn. Soc., xiii (1820), p. 179—Java.

Not obtained by the Survey. The Drongo-Cuckoo is so far only recorded from the south of the Presidency and there it is mostly confined to the western side. A fine adult captured in the Museum compound at Madras on 14 October 1879 (Dique, S.F., ix, p. 298) provides the only record from the east.

Jerdon says that he procured it in the Wynaad. A male obtained in April 1878 on the Coonoor Ghat (Wardlaw-Ramsay) is in the British Museum. In South Travancore, according to Ferguson it is not uncommon, and probably resident, in the low country in open forest land.

According to Stuart Baker (Nidification, iii, p. 355) the breeding season in Travancore is from January to March and an egg believed to be of this species is described.

There has been some difference of opinion as to the race to which these South Indian and Ceylon birds are to be referred. Stresemann (Nov. Zool., xx, p. 340, et seq.) refers them to the typical race. Stuart Baker, however (Nov. Zool., xxvi, p. 293), considers them separable and provides them with the name of *S. l. stewarti*. I have been into the question carefully and can find no means of separating these birds from the typical race. There appears to be no difference in size, colour or wing-formula. *S. l. brachyura* of the Malay Peninsula has a much shorter and less deeply forked tail while *S. l. dicruroides* of the Himalayas is a larger bird.

Clamator jacobinus jacobinus (Boddaert).

Cuculus jacobinus Boddaert, Tabl. Pl. Enlum. (1783), p. 53 for Pl. Enlum., 872—Coromandel Coast.

Specimens collected:—95 ♀ 20-4-29, 105 ♂ 21-4-29, 127 ♂ 25-4-29, 155 ♂ 29-4-29 Kurumbapatti; 475 ♀ 23-6-29, 476 ♀ 24-6-29 Tirthamalai 1,000 ft.; 855 ♂ 30-9-29, 924 ♀ 17-10-29 Seschachalam Hills 2,000 ft.; 984 ♀ 8-11-29 Nallamalai range 2,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
4 ♂	24-27	141-146	157-165	25·5-27·5 mm.
5 ♀	25	140-146	155·5-161	25-27·5 mm.

The Pied Crested Cuckoo is not recorded in the Presidency north of the Nallamalai Range where the Survey obtained a specimen. In the Seschachalam Hills it was found to be common. In the Madras District, Capt. Bates informs me that it is by no means uncommon and that he has noted it in every month of the year. He also says that he saw it at Palmaner on 25 July. In Salem District, La Personne says that it was fairly well distributed throughout the plains area, preferably in the forested tracts, though it was not observed in the hills. It was common at Harur and Tirthamalai. At Kurumbapatti the birds were paired and very noisy by the first week in May, every part of the jungle seeming to have its own pair.

How far north this resident form occurs on the western side is not very clear, as the only specimen I have examined from the Nilgiris undoubtedly belongs to the migratory race. In Travancore, Ferguson says the Pied Crested Cuckoo is a resident and fairly common in the low country, more especially towards the extreme south. Jerdon found it breeding at Coimbatore. Davison records that while he had seen it only occasionally in the Wynaad it is common in the Nilgiris, being most numerous perhaps about cultivation round Ootacamund, Coonoor, Kotagherry and similar localities. On the western slopes, however, Mr. Betts informs me that it is scarce, occurring only at low elevations so it is possible that hereabouts we have the boundary between the two forms.

Rhodes Morgan considers the breeding season to be from about March to May and this agrees well with Capt. Bates' belief that about Madras it breeds in April and May. The female shot at Kurumbapatti on 20 April was laying eggs. Mr. Theobald, however, took an oviduct egg at Utnoor, Salem, as late as 18 August (N. & E., ii, 388).

An albinistic specimen from Madras is recorded (Dique, S.F., ix, 508).

In the *Journal* for September 1928 (vol. xxxiii, pp. 136-44) I attempted to enumerate and summarise the result of the records of this cuckoo in an endeavour to find the winter quarters of the huge numbers of Pied Crested Cuckoos which arrive to breed in the rains over a vast area of Northern and Central India. I then pointed out that only Southern and South-eastern India remained as a possible wintering place for these birds if they did not go to Africa. The former suggestion is now, I think, ruled out by the Survey which certainly never found this cuckoo in the numbers which one would expect if all the northern birds came south and only found the smaller race. To my mind there is now little doubt that the larger form winters in Africa.

The Survey has cleared up a further point. The original type locality of Boddaert's *Cuculus jacobinus* is the Coromandel Coast, that is the South-east coast of India from about the mouth of the Kistna to the Palk Straits. This area is inhabited not by the larger migrant form which has hitherto been considered the typical race but by the smaller resident bird which is identical with the resident Ceylon bird named *taprobanus* by Hartert [Nov. Zool., vol. xxii (1915), p. 254—Ceylon]. This is clear from the measurements. The complete series of Ceylon birds in the British Museum is as follows:—

	Bill.	Wing.
2 ♂	24-25	138·5-141
2 ♀	25-25·5	140·5-142·5
8 unsexed	25-25·5	138-143·5
Total variation 12 birds	24-25·5	138-143·5

A series of birds from N.-W. India (Kashmir, Punjab, United Provinces) measure:—

	Bill.	Wing.
12 ♂	25-28	146-155
8 ♀	24·5-28	144-151
Total variation 20 birds	24·5-28	144-155

There is no difference in plumage. Captain Bates has kindly sent me two birds (unsexed) from Madras to supplement the survey series. They measure:—bill 25-25·5, wing 140-142 mm. *Taprobanus* the name hitherto used for this form therefore becomes a synonym of the typical form. *Cuculus pica* Hempr. and Ehr., Symb. Phys. (1833), folio 2, note—type locality Ambukahl, Dongola appears to be the oldest name applicable to the larger northern bird which may in future, therefore, be known as *Clamator jacobinus pica* (Hempr. & Ehr.).

Clamator jacobinus pica (Hempr. & Ehr.).

Cuculus pica Hempr. & Ehr., Symb. Phys. (1833), folio 2, no , Ambukahl, Dongola.

As remarked under the last form this migratory race of the Pied Crested Cuckoo certainly occurs in the north-west corner of the Presidency. There is a male in the British Museum collected by Wardlaw-Ramsay on 23 August 1876 at Coonoor 6,000 ft. which has a bill of 25 mm. and wing of 152 mm. There is however nothing else to show whether the birds said by Davison to be common on the Nilgiris are resident or migratory or to which form they belong.

Clamator coromandus (Linnaeus).

Cuculus coromandus Linnaeus, Syst. Nat., ed. xii, vol. i (1766), p. 171—Coromandel Coast.

The Red-winged Crested Cuckoo was not met by the Survey but it is probably a regular winter visitor and passage migrant in small numbers to the Presidency. Jerdon says that he had seen it in the Carnatic and there is a skin from 'Madras' in the Hume collection. Dewar says that he saw it in Guindy Park and that he also saw one in Colonel Carruther's aviary that had been caught in that officer's compound in Madras. A skin dated 1871 from Trichinopoly is in the Hume collection.

On the west William Davison mentions (S.F., x, 360) a report of one shot by a native taxidermist in the S.-E. Wynaad. Miss Cockburn sent Hume a specimen (now in the British Museum) shot at Kotagherry on 5 December 1874.

Ferguson mentions two winter specimens, then in the Trivandrum Museum, shot at 2,500 ft. and 4,000 ft. respectively on Ponmudi in 1892.

In Ceylon it is somewhat better known.

Eudynamys scolopaceus scolopaceus (Linnaeus).

Cuculus scolopaceus Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 111—Bengal.

Specimens collected:—326 ♂ 3-6-29, 411 ♂ 14-6-29 Chitteri Range 2,000-3,000 ft.; 708 ♀ 18-8-29 Palkonda Hills 1,000 ft.; 937 ♂ 20-10-29 Seschachalam Hills 2,000 ft.; 1207 ♀ 8-1-30 Godavery Delta.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
3 ♂	29-30·5	187·5-193	186-195	32-35 mm.
2 ♀	29·5-31	194	190-192	30·5-31·5 mm.

There appears to be no record of the Common Koel in the Presidency north of the Godavery Delta where a female was procured by the Survey on a wooded island. This specimen is more fulvous than usual on the crown and throat but the bill is too small for *malayana* and it must certainly belong to the typical form as do Blanford's specimens from Badrachalam (♂ 17-2-71) and Rajamundry (♂ 30-5-71). Other specimens were collected in the Palkonda and Seschachalam Hills and at Madras the Koel is very common, according to Dewar. The Survey reported it common on the Shevaroys and plentiful on the Chitteri Range, frequenting both hill and plains forest in that area. Undated specimens from Arcot and Trichinopoly are in the British Museum.

In Coorg according to Betts the Koel is only a casual visitor. William Davison found them common and very noisy in the Wynaad in March and April, and also not uncommon about the lower slopes of the Nilgiris. He remarks that he once shot a pair at Ootacamund but their occurrence at that altitude is quite unusual. Specimens from Tellicherry (♂ 11-10-82 Wardlaw-Ramsay) and Calicut (January 1873 Hume collection) are also in the British Museum.

In the Nelliampathies according to Kinloch the bird does not occur. Fairbank, however, observed it a few times in the Palnis. In Travancore it is said to be resident but not very common, being found occasionally both in the hills and low country.

Mr. A. G. Cardew C. S. found various Koels' eggs in House-Crows' nests at Madras in the last week of June (N. & E., ii, 396). With this exception there are no breeding records for the Presidency and we have no accurate information as to its status though it appears to be resident.

Rhopodytes viridirostris (Jerdon).

Zanclostomus viridirostris Jerdon, Madr. Jour. Lit. Sci., vol. xi (1840), p. 223—Bottom of the Coonoor Pass.

Specimens collected:—58-59 ♂ ♀ 15-4-29 Kurumbapatti; 331 ♂ 5-6-29, 348 ♀ 6-6-29, 360 ♂ imm. 7-6-29, 370-371 ♂ ♂ 9-6-29, 404 ♂ imm. 14-6-29 Chitteri Range 2,000-3,000 ft.; 458 ♂ 21-6-29 Tirthamalai 1,000 ft.; 536 ♀ 8-7-29 Vyampatti, Trichinopoly; 674 ♂ 10-8-29 Palkonda Hills 1,000 ft.; 901 ♂

11-10-29 Seschachalam Hills 2,000 ft.; 1042 o? 28-11-29 Nallamalai Range 2,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
7 ♂ ad.	29·5-32	132·5-138	207-235	32·5-35·5 mm.
2 ♂ juv.	29-30	128·5-130	212-215	33-34 mm.
3 ♀ ad.	29-32·5	129-139·5	218-228	32-34 mm.

There has always been some doubt as to the northern limits of the Small Green-billed Malkoha on the eastern side of India. Hume doubted Ball's statement that it occurred at Midnapore (S.F., vii, p. 207) while Jerdon's statement that it occurs as far north as Cuttack (B. of I., i, p. 347) was evidently only based on specimen 'A' in Blyth's Catalogue (p. 76) which was purchased in 1847. It certainly occurs, however, in Orissa for a female collected by Walton at Chamundia, Daspalla on 22 January 1902 is in the Society's collection.

The most northern record for the Presidency is Blanford's specimen in the British Museum collected north of Ellore (♀ 5-4-1871). South of the Godavery it appears to be fairly general and common down to the Cauvery River, south of which I have no information beyond the fact that it occurs on Rameswaram Island (S.F., iv, 458). In Cuddapah District La Personne says that it is common in bamboo and other forests. In Salem District he found it extremely common from the foot of the Shevaroys to Tirthamalai both in the hill and plains forests. Captain Bates informs me that it is not uncommon in the Reserved forests round the groups of isolated hills near Madras, there being apparently a pair to every hill. He adds the following note:—they seem very attached to certain localities and on revisiting certain hills at considerable intervals of time, I have almost always succeeded in finding the birds within a hundred yards or so of where they were first noted. They are skulkers with much the same habits as the Crow-Pheasant, though I have never seen one actually on the ground. When caught in the open they often 'freeze', sometimes in the most grotesque attitudes, hoping thereby to escape detection.

This Malkoha is also fairly common on the western side of the Presidency. There are two specimens from Calicut in the Hume collection. William Davison says that it does not ascend the hills but occurs, though never very numerously, in the better wooded parts of the Wynaad and the country about the base of the Nilgiris. A specimen in the British Museum was, however, killed as high as 3,000 ft. on the Coonoor Ghat. Jerdon mentions its partiality for the large hedges of *Euphorbia* in the Coimbatore District. Colonel Sparrow informs me that it occurs near Malappuram. Fairbank met with 4 in all in thickets at the eastern base of the Palnis. In Travancore Ferguson says it is not uncommon about the base of the hills in open forest and he shot it as high as 3,000 ft. at Pirmade.

As to the breeding season Mr. A. G. Cardew obtained 2 eggs from a nest near Wandiwash (North Arcot) on 10 March (Hume, N. & E., ii, p. 399). La Personne considered that they were breeding at Kurumbapatti in April and in the Shevaroy-Tirthamalai area in May and June. A fledged young bird was seen at Chitteri on 23 June. This appears late however, as the above series contains young birds in post-juvenal moult in June.

The only variation that I can find in specimens of this Malkoha from India and Ceylon lies in the white tips to the tail feathers. In specimens from Ceylon these tips are very deep and in some cases the ends of the shorter feathers almost touch the bases of the white tips of the next in the series, so that the sides of the tail appear white from below. In 15 specimens the tips of the second tail feathers (counting from the outside and measuring the greatest length of white which is on the outer web) vary in depth from 35 to 51 millimetres. In the third tail-feather the variation is from 33.5 to 50 mm. In a small series from South Konkan the white tips are much narrower, the corresponding measurements being 33 to 37 and 28.5 to 37.5 mm. There is, however, such complete intergradation between these two extremes from south to north and the difference at best is so small, that there is no reason to recognise two races.

It does, however, appear probable that *viridirostris* should itself be grouped with other members of the genus as subspecies of one widely distributed species, but I am unwilling to suggest such an arrangement without further study of the group as a whole.

Phoenicophaus pyrrhocephalus (Pennant).

Cuculus pyrrhocephalus Pennant, Ind. Zool. (1769), p. 16, pl. vi—Ceylon.

According to Stuart Baker (*New Fauna*, iii, p. 182 and Nidification, vol. iii, p. 364) the Red-faced Malkoha, which has hitherto been recorded as peculiar to Ceylon, occurs in the extreme south of Travancore where Mr. Stewart is said to have taken eggs in April and May.

Taccocua leschenaultii leschenaultii Lesson.

Taccocua leschenaultii Lesson, Traite' d' Orn. (9 May 1830), p. 144—India, now restricted to Madras.

Specimens collected:—768 ♀ 28-8-29 Palkonda Hills 1,000 ft.; 858 ♂ 1-10-29 Seschachalam Hills 2,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
1 ♂	30·5	154	229·5	43·5 mm.
1 ♀	29·5	148	211	45 mm.

The Sirkeer Cuckoo appears to be scarce throughout the Presidency. The only records of this form on the eastern side, other than Jerdon's general remark that he had procured it on the Eastern Ghats, are furnished by the above two survey specimens.

On the western side the Sirkeer is found but is rare on the Nilgiris. Jerdon and William Davison both record that they met it up to 5,000-6,000 ft. elevation. Miss Cockburn considered it was confined to the lower slopes. A specimen collected by her near Kotagherry on 23 September 1874 is in the British Museum.

In Travancore Ferguson says that he met it once only, in the low country. There is one 'Anjango' specimen in the British Museum.

The only hint of the breeding season in our area is furnished by Miss Cockburn's statement that the only nest she ever found contained 2 eggs in March.

In the J.B.N.H.S., vol. xxviii, p. 158, Mr. Stuart Baker restricted the type locality of *leschenaultii* to Kanara, Bombay, an unfortunate choice as that is an area where the birds are intermediate in character between *leschenaultii* and *sirkee*. It cannot however be considered correct as Lesson received his specimen from the French Traveller M. Leschenault de la Tour who visited India in 1816 remaining some time at Pondicherry and then travelling up the line of Eastern Ghats to Bengal from where he went to Ceylon and then France. However in the *New Fauna*, vol. vii, p. 337, Stuart Baker has dropped his restriction and says that 'India' may be considered as equal to Madras and to that district I now restrict it, as it lies within the sphere of M. Leschenault's activities.

It may also be noted that Stuart Baker is clearly wrong in placing Blyth's *Taccocua infuscata* in the North-Western Himalayas. In his footnote to p. 187 Baker presumes that Blyth must be referring to the West Himalayan bird because 'he describes his bird as pale and large' and again because in later describing *affinis* from Bengal he 'lays stress on the dark plumage'. A reference to the original descriptions removes these difficulties. Blyth did not describe the bird as pale and large but speaks of the 'larger size and infuscated colouring', a very different matter and in agreement with the darker colouration that he proceeds to elaborate; while in describing *affinis* he says it 'combines the size of *Taccocua sirkee* with the colouring of *Taccocua infuscata*', that is to say he does not attempt, as Stuart Baker implies, to distinguish between the colouration of the two forms. As a matter of fact there need have been no doubt in the matter at all, as Ticehurst points out (J.B.N.H.S., xxxiv, 471), for Blyth's type specimen came from the Terai region near Darjeeling. I cannot, moreover, substantiate the wing limit of 186 mm. as given by Stuart Baker and suggest that this is a misprint for 168 mm.

Taccocua leschenaultii affinis Blyth.

Taccocua affinis Blyth, J.A.S.B., vol. xv (1846), p. 19—Rajmahal.
Specimen collected:—1534 ♂ 13-3-30 Sankrametta 3,500 ft.

Measurements:—

Bill.	Wing.	Tail.	Tarsus.
31·5	153·5	233	46·5 mm.

The single specimen of the Sirkeer Cuckoo met and collected by the Survey in the Vizagapatam Hills can certainly not be attributed to the typical race as it stands out markedly from the other specimens by the richness of its colouration which is much darker both above and below, in this agreeing with the East Himalayan form *T. l. infuscata.* It agrees with a number of other birds in the British Museum from neighbouring areas, Muddapur, Maunbhum, Palamow, Hazaribagh, Sambalpur, Raipur and Badrachalam and a series of fifteen such birds measure:—bill 31.5-33, wing 148-158 mm. This is noticeably smaller than true *T. l. infuscata* of which I measured four specimens from the Eastern Terai:—bill 34-35, wing 160-163 mm., and the series evidently belong to the intermediate form which Blyth named from the Rajmahal Hills and Monghyr as being the same colour as *infuscata* but smaller. It is not perhaps a very good race but it may be recognised. Mr. Stuart Baker's error in placing the type locality of *T. l. infuscata* in the Western Himalayas has led him to include the East Himalayan bird with these intermediates under the name *affinis*, but if it is considered desirable to keep them together the name *infuscata* (1845 after July) will of course take precedence.

Ball's record (S.F., vii, 208) of the Sirkeer from Jeypore is the only other record of this form in the Presidency.

Centropus sinensis parroti Stresemann.

Centropus sinensis parroti Stresemann, Nov. Zool., vol. xx (1913), p. 323—Ceylon.

Specimens collected:—124 ♂ 24-4-29 Kurumbapatti; 266 ♂ 22-5-29, 283 ♂ 25-5-29 Shevaroy Hills; 341 ♂ 6-6-29, 363 ♀ 8-5-29, 378-380 ♂♂♂ 11-6-29 Chitteri Range 2,000-3,000 ft.; 682 ♂ 12-8-29 Palkonda Hills 500 ft.; 814 [♀] 13-9-29 Kodur 500 ft.; 1376 ♂ 12-2-30 Anantagiri 3,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
9 ♂	37-40.5	176-194	220-251	42-51 mm.
2 ♀	38-41.5	183-199	223-256	49-51.5 mm.

The Common Crow-Pheasant seems to be a common and generally distributed resident species in the Presidency, though on the eastern side there is no definite record for the area between Anantagiri, where a specimen was procured by the Survey, and Madras. About the latter city Dewar tells us it is common, one to be seen in almost every garden of any size. The Survey specimens complete the records on this side save for a specimen in the Society's collection collected by Mr. Prater at Madura in May 1917. La Personne comments on the grotesqueness of the display and its lack of harmony of movement or appropriateness of sound. A step forward and one sideways and then a backward strut, accompanied by some hideous sound that might be either a croak or an oath!

On the west it is very common everywhere in Coorg (Betts) in the Wynaad (William Davison) and all over the Nilgiris, more plentiful on the slopes and less numerous on the plateau (Davison and Betts). In the Nelliampathies, however, Kinloch considered it merely an occasional straggler to the northern slopes in the hot weather, though Fairbank observed it up to 5,500 ft. in the Palnis. In Travancore it is very abundant in the low country and about the foot of the hills (Ferguson). There is a good series of skins from these areas in the British Museum.

In the Nilgiris Miss Cockburn considered the breeding season to be in March and April (N. & E., ii, 403) and Betts found nests at 6,500 ft. in April and August. In Travancore Ferguson found eggs in June and August. Mr. Cardew found a nest with eggs just ready to be hatched on 9 March and another with one fresh egg on 20 July. This was at Madras.

All Presidency birds belong to the race *parroti* which was described from Ceylon. The *New Fauna* (vol. iv, p. 189) lays emphasis on the colours of the under wing-coverts and inter-scapulary area in the keys to the species and subspecies. This requires a word of caution. Of twelve specimens of *parroti* that lie before me at the moment nine show a greater or less amount of chestnut on the under wing-coverts, in face of the statement in the key that the under wing-coverts of this species are never chestnut. As regards the inter-scapulars, this is a feature which is not easy to assess; if the scapulars are parted there is in some birds a distinct but narrow band of chestnut joining them; in others there is as clearly no such band, the black of the hind neck and rump being uninterrupted. These birds follow the subspecific key well enough. But there are in addition a number of specimens which one would hesitate to assign clearly to either group, for the character is one which is affected by make of skin and sit of the feathers and there is much intergrading between the two extremes.

The brownish colour of crown, chin and throat in many specimens appears to be largely due to wear. The sooty wash on the coverts and inner secondaries and tertiaries found in some specimens is due to individual variation, but it appears to be to some extent subspecific in character, in that it is more frequently found in *parroti* than in *sinensis*.

Attention needs to be paid to the question of juvenile plumage in this species. Some young birds are similar to the adult, others wear a barred plumage, and this may also be of subspecific significance, but I have not seen sufficient specimens to settle the point.

Centropus benghalensis (Gmel.) subsp.?

Cuculus benghalensis Gmelin, Syst. Nat., vol. i, pt. i (1788), p. 412—Bengal.

The Lesser Coucal is confined to the western side of the Presidency and even there it must be very local. William Davison says that he met with it on some half-dozen occasions in the Wynaad, always in long grass.

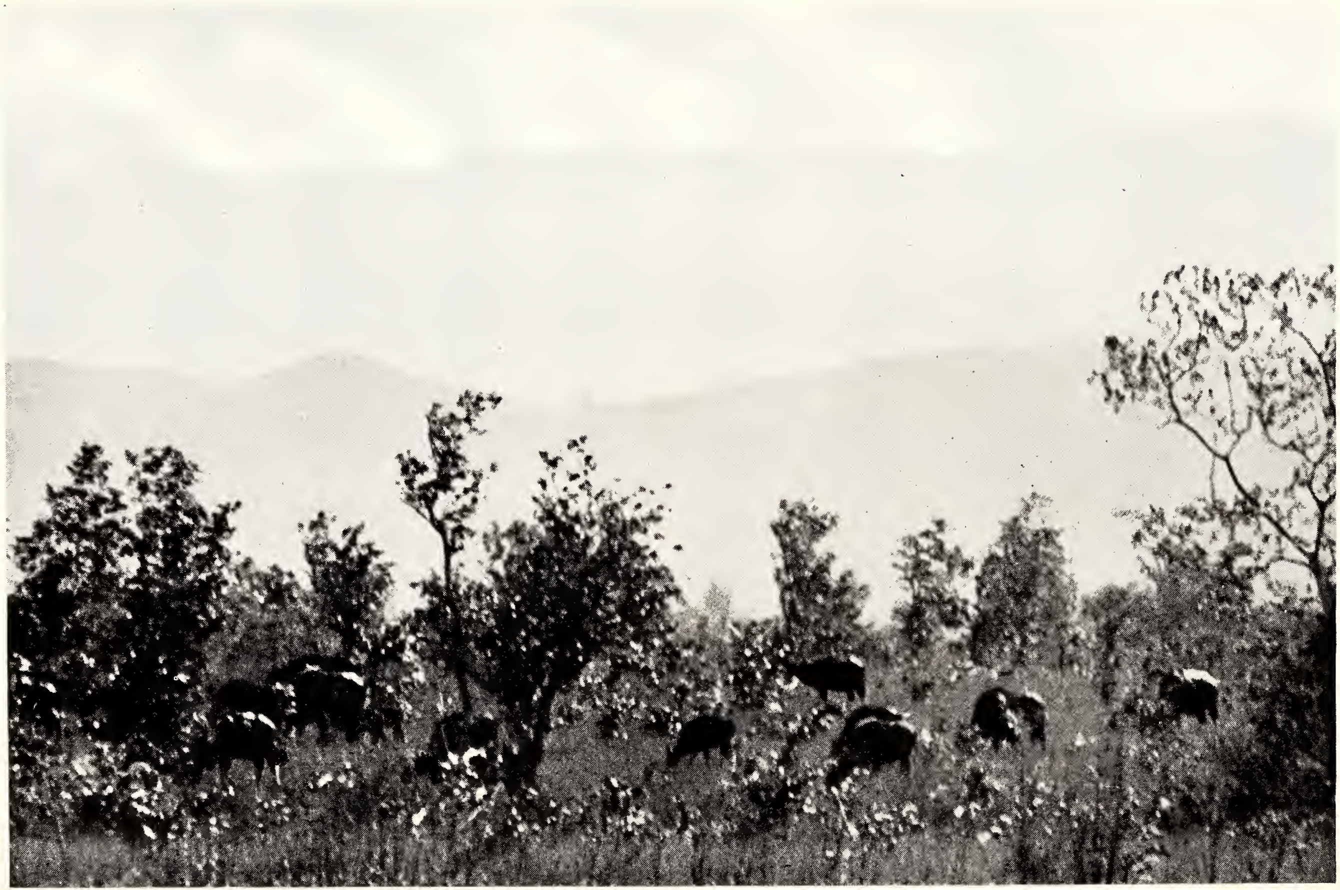
In Travancore Ferguson says it is not uncommon in the hills, where also it frequents grassland.

There are six specimens in the British Museum, all said to have come from Peermade. They lack precise data and all appear to be females. In the absence of a better series I am unable to elucidate the question of the exact race of this species which occurs in the presidency. The plumage stages are complicated and difficult to understand and they must certainly be fully worked out before the races of this species can be properly elucidated as the bird has a wide range towards South-East Asia. I am, however, satisfied that these Travancore birds do not belong to the typical race, to which they are attributed in the *New Fauna*.

Nothing seems to have been recorded about the breeding in the Presidency.

(*To be continued*).

PLATE I.



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A herd of Bison (*Bibos gaurus*, H. Sm.) grazing in sparse jungle.

IN AMBUSH FOR BISON.[1]

(A Big Game Photographer's Fortune and Misfortune in Burma.)

BY

E. H. Peacock.

(*With 3 plates*).

If my memory is not at fault, Major Evans in his book: *Big Game Shooting in Upper Burma,* mentions having seen a herd of a hundred bison on the *lwins* (grassy plains) north of Homalin in the Upper Chindwin District, several years ago. This must have been a momentous sight, but very likely it was due to a temporary gathering of two or more bison herds.

When the new grass has begun to sprout after the annual ground fires of March and April, bison will habitually frequent suitably remote *lwins*, and, if undisturbed, will feed greedily every morning and evening on the tender grass shoots. At such times small herds will often amalgamate to form large ones.

Ordinarily, a collection of 20 bison would be considered a fairly large herd, but I have seen much greater herds on many a lonely *lwin* in the northern drainages of the Irrawaddy and Chindwin rivers.

I recollect having seen, about ten years ago, an immense herd of bison on one of the many fine *lwins* that lie between the great Indaw Lake and Shwedwin Village on the Uyu river. I counted over 50 animals in this herd, but there must have been about 60 all told, if not more. Some of the *lwins* in this region are immense plains of short *thekhe* grass interspersed with patches and belts of woods. At that time villages were few and far between, and the game lived out on the *lwins* for much of the dry season and the early rains. What glorious country that was for a sanctuary and ultimately, perhaps, a game park.

The two principal sanctuaries in Upper Burma are so small that one might walk across either of them in less than a day; yet they can show during May and June, when the herds from the surrounding forests gather and amalgamate on the *lwins*, collections of bison numbering 50 or more.

The photograph at the head of the opposite page shows 29 animals, but the herd of which they were a part consisted of 45 bison, including calves—a sufficiently impressive sight. The members of this herd were so spread out that it was impossible to include them all on one negative. On this occasion the wind persisted in the right direction and the whole herd walked, figuratively, over the bushes behind which I was concealed; but, in the failing light, as they drew near to me, their movements blurred the images obtained from the time exposures I was obliged to make, and when they detected me they galloped away.

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[1] Reprinted by courtesy of *The Field*.

One is so annoyingly at the mercy of one's subject in this branch of photography: not in any physical sense, I hasten to aver, because the 'dangers and difficulties' of animal photography as opposed to big game shooting have been so much overdone, that I would not unwittingly support the fallacy. One really fine old bison, fairly sought, tracked and shot under good game laws, is likely, especially when wounded, to create more difficulty and thrills than the photography of a dozen assorted groups on *lwins*, at 'licks' and waterholes, and from the backs of elephants; which is a fact too easily misunderstood or hidden from the photographer who is not also a hunter.

The young bison calves always strike one as being remarkably foreign to their parents; their light brown, sometimes fawn-coloured coats are much opposed to the black bodies of the mature animals. They are funny, ungainly-looking things when very young.

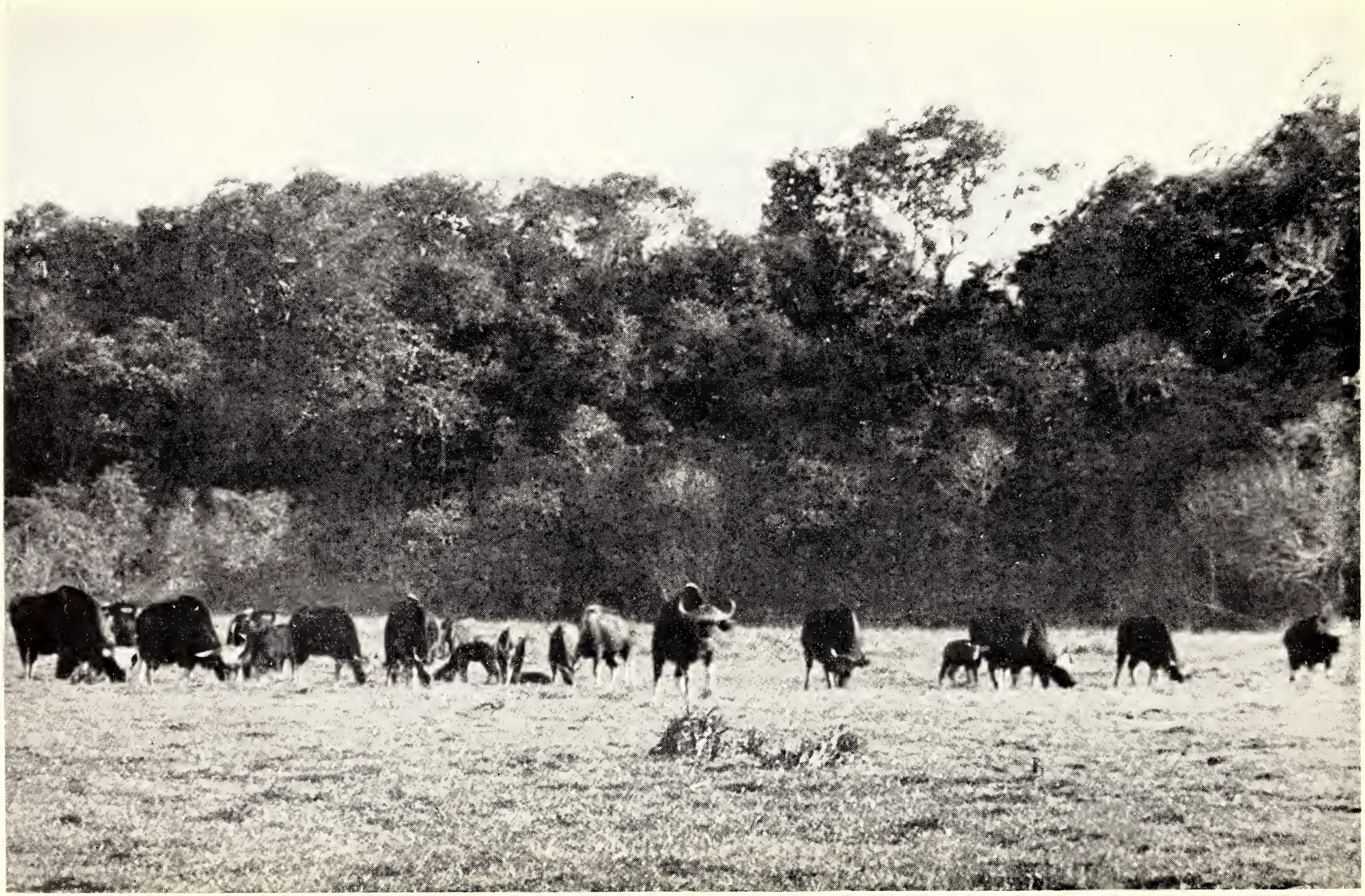
In 1920, while hunting in the Kyauklebin forests of the Ruby Mines District with the local guides, Maung Naing and Maung Ba, I met a young bison calf that had become separated from its relations. With the wind behind him, this young bull walked right up and studied us from within 10 ft. with the greatest curiosity and no atom of fear; yet, when we circled round him and he smelt the taint of human presence, he at once galloped off with every sign of fear and unease.

It is interesting when examining the enlarged image of such a group as that shown opposite to remark features that have not been observed in life; for instance, plate II shows a cow with one perfectly straight horn, but the other curved in the usual way. I failed to observe this feature at the time of making the exposures.

One photograph provided some mild thrills. I had worked myself into position, in breast-high grass, directly in front of the herd, just as it was about to emerge from the forest. It was very late in the evening, and, with a moderate aperture, I was obliged to make exposures varying from two to five seconds, depending on the degree of mobility in the herd at the time of making the exposures. The camera-tripod and much of myself were, of necessity, well clear of the grass, and I was soon detected.

A young bull saw me first, and complicated matters by moving out of the picture and trotting up within 20 yds. on my right front, where he stamped and snorted in company with a curious-minded cow which had followed him. I remained perfectly still, which puzzled him; but when I moved gently in focusing and photographing the main herd, the young brute stampeded back to his companions and set them all snorting and staring. Nevertheless, they continued to advance slowly in a closely packed line, some tossing their heads and staring curiously, others quite placid and obviously of opinion that it was merely another instance of 'that young fool's false alarms!'

The forester who was crouched behind me became nervous, and whispered excitedly: 'They'll think we are tigers. They'll ring us round and charge.' Of course, they were unlikely to do anything of the sort, and in due course, when I grew over-anxious to get a picture from well above the level of the high grass, some intelligent



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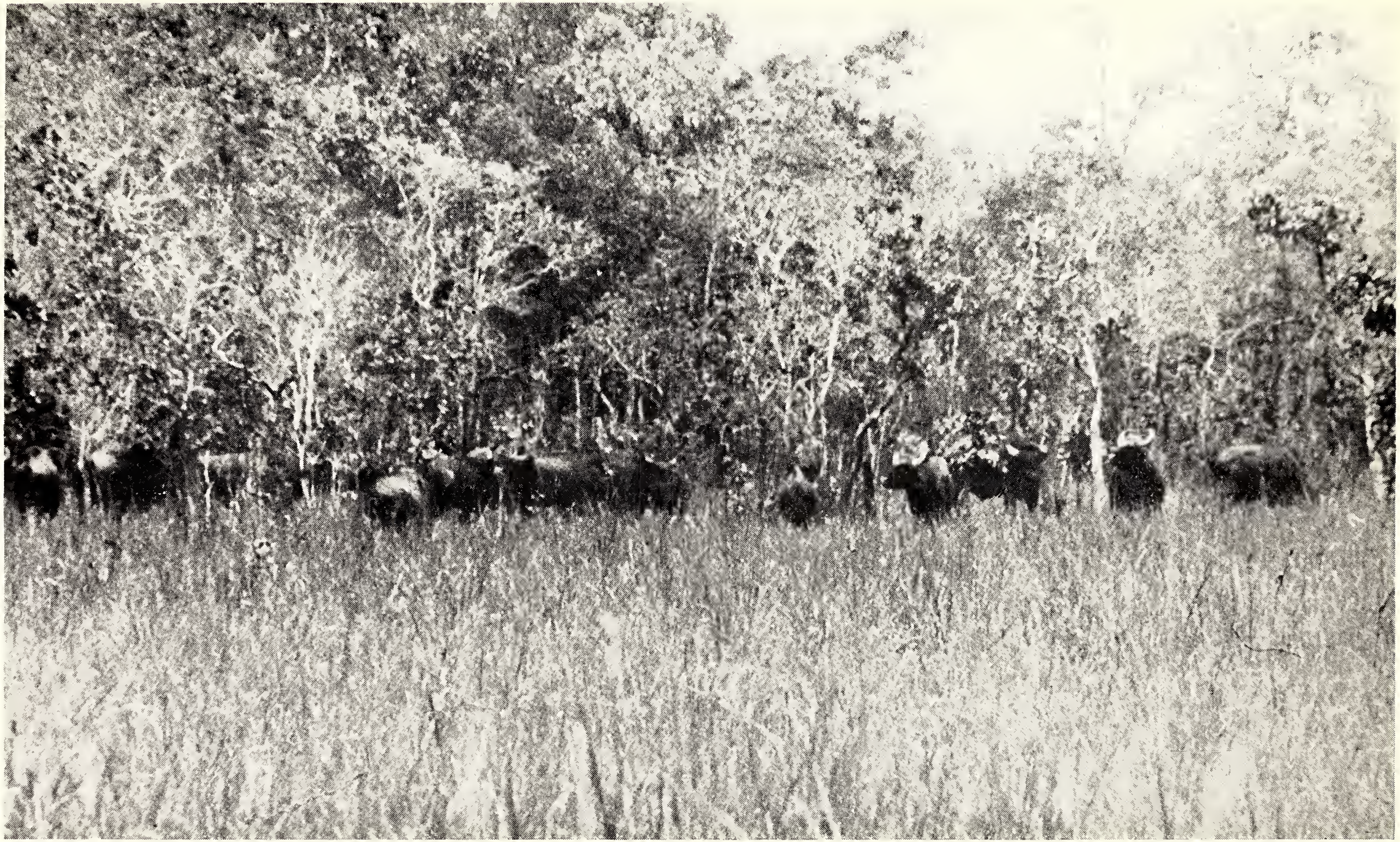
Part of a herd of Bison (*Bibos gaurus*, H. Sm.) grazing on a small *lwin* or plain.



Copyright of *H. E. Peacock.*

A herd of Bison (*Bibos gaurus*, H. Sm.) on the edge of the forest.

elders of the herd made out that I was a man; whereupon the herd departed, and did not dwell on the order of its going.

Bison rest or sleep in heavy cover between, roughly, 10 o'clock and 3 o'clock in the daytime, and seldom come out of cover until the light has definitely begun to fade or until it has become quite dark. When they feel secure, however, they may lie up in light forests, or move through thin forests on their way to the grazing grounds while the sun is still high above the horizon.

The herd shown in my first photograph was behaving in just such an unbisonlike manner, so, thinking I had plenty of time, I contented myself with a couple of long range photographs, and delayed a nearer approach till it should reach a more easily-stalked position. Unfortunately, this herd moved off into heavy forest through which I must track it for a mile or more till it emerged into a most beautiful little *lwin*, where it settled down to serious grazing.

The setting of this *lwin* and the bison, on the slope of a hill with dark woods on one side and hills and clouds for background, was so fine that I hurried my stalk and was detected before I had got my camera clear of the tangle of weeds and grass through which I was crawling. This was a most exasperating moment: the bison, about 20 of them, had bunched together in alarm and presented a fascinating group in a splendid setting within easy camera range; but I was confined to shoulder-high grass, and the tripod, at its highest, would not raise the camera lens above the top of the grass, neither would the light permit of an instantaneous exposure with the camera held high in my hands.

I tried to move into a better position, but it was quite hopeless; and, after staring and snorting for a good ten seconds, these most unsatisfactory camera-subjects presented me with a last sight of their tails as they disappeared into the forest.

REVISION OF
THE FLORA OF THE BOMBAY PRESIDENCY.

BY

THE LATE E. BLATTER, S.J., Ph.D., F.L.S.

PART XXV.

(*Continued from page 277 of this volume*).

CYPERACEAE

BY

THE LATE E. BLATTER, S.J., Ph.D., F.L.S., and C. McCANN, F.L.S.

(*With 4 plates and 1 text photo*).

5. MARISCUS Vahl (Cke. under *Cyperus*).

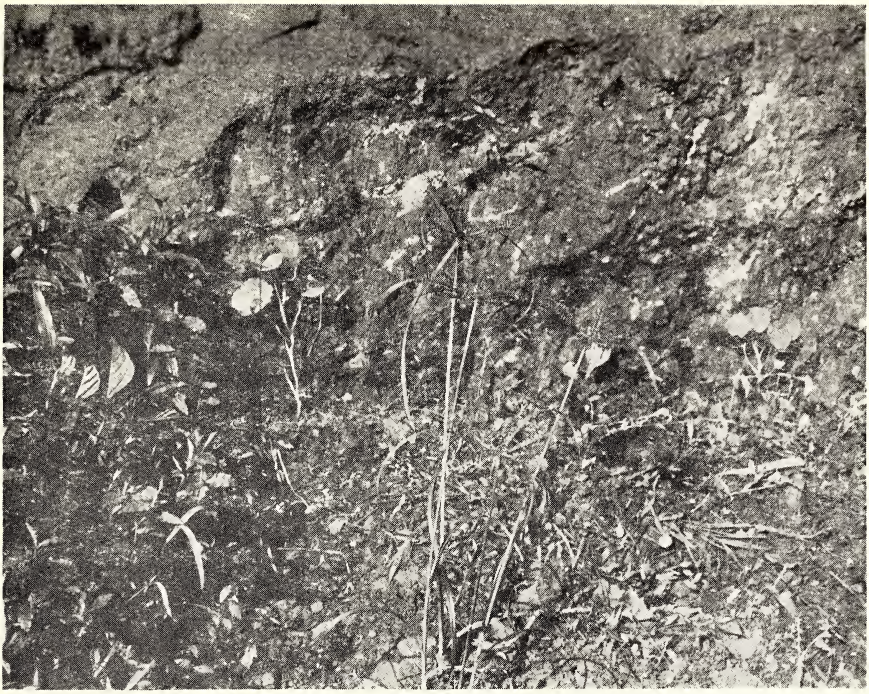
Erect herbs, usually perennial and glabrous; generally resembling the genus *Cyperus*. Inflorescence of a single head or in simple or compound umbels. Spikelets usually in compact compressed or terete heads. Glumes distichous, persistent on the rhachilla which disarticulates above the 2 lowest (which are empty and smaller than the rest) leaving a small knob or disk with, sometimes, an annular ridge on its summit. Stamens usually 3. Style 3-fid, continuous with the ovary; stigmas slender. Nut trigonous.—Species about 50. —Cosmopolitan.

A. Base of stem oblong, thickened by the turgid membranous sheaths
  I. Stolons 0 ... ... 1. *M. Blatteri.*
  II. Stolons slender ... ... 2. *M. bulbosus.*
B. Base of stem not thickened by sheaths. Stem tall, or when short, thin slender. Spikelets narrow, not turgid, pale, bearing 1-3, rarely 4, nuts ... ... 3. *M. paniceus.*
C. A much larger and coarser plant than B. Umbel large, rays up to 17 cm. Spikes digitate on the rays. Spikelets fewer and more distant, subsecund, larger, 9 mm. ... 4. *M. konkanensis.*
D. Stem tall. Spikelets pale, turgid, bearing several nuts ... ... 5. *M. pennatus.*
E. Stem tall, robust. Umbel large, spreading. Spikelets innumerable in globose spikes, very narrow, almost filiform, golden red ... 6. *M. compactus.*

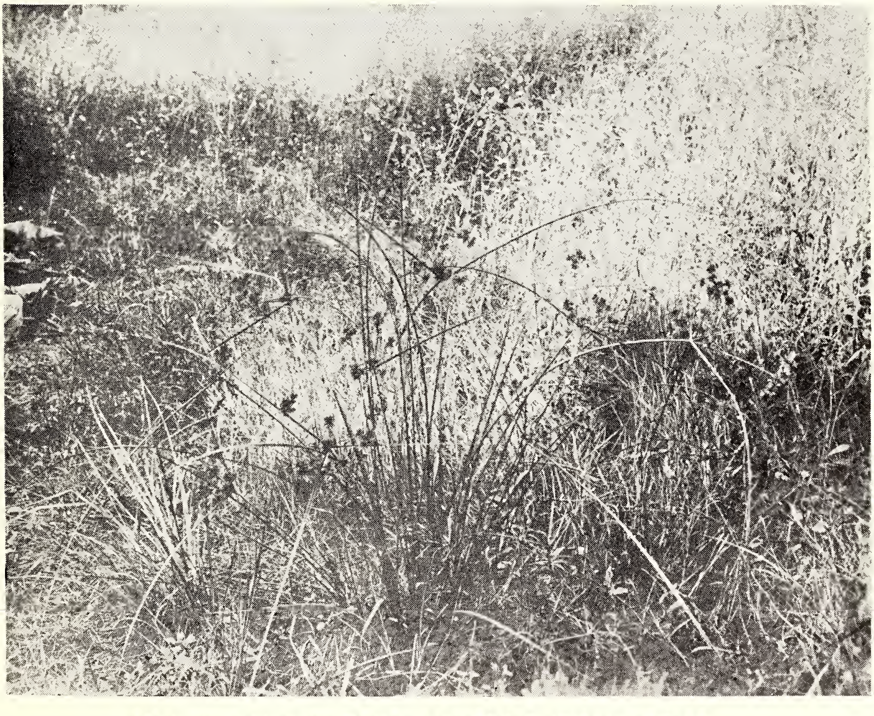
1. **Mariscus Blatteri** McCann, *sp. nov.*

[*Pertinet ad sectionem Marisci bulbocaulis. Accedit ad Mariscum dregeanum* Kunth *a quo tamen distingui potest culmo usque ad* 70 *cm. longo, foliis culmo brevioribus vel longioribus* (*usque ad* 88 *cm.*) 6 *mm. latis, acumine acuminatissimo, margine et venis in facie superiore scabris, marginibus minutim serrulatis, inflorescentia multo maiore* (24×19 *mm.*), *bracteis usque ad* 9, *infima* 34.5 *cm.*×6 *mm. attingente, spicula multo longiore duas continente nuces, squama sterili superiore ad apicem biloba cum arista longa vel brevi in sinu, rhachilla alis oblique oblongis munita, staminibus* 3, *nuce quam gluma aliquantulum breviore.*]

Description: Stolons 0. Roots numerous, fibrous, dark brown. Stems tufted, at base, broadly ovoid, thickened by the light brown leaf-sheaths, up



Mariscus paniceus Vahl at Panchgani.



Mariscus compactus Druce, near Malad, Salsette Island.

Photos by C. McCann.

Fimbristylis tetragona R. Br. growing in a marsh at Mulland, Salsette Island.

A formation of *Fimbristylis aestivalis* Vahl and *F. dichotoma* Vahl growing in a marsh at Khandala, W. Ghats.

Photos by C. McCann.

to 70 cm. long, slender, trigonous, smooth (striate in dry specimens). Leaves as long as the stem or longer reaching 88 cm. by 6 mm., weak, grass-like, tips finely acuminate, margins and veins of upper surface scabrous, the margins minutely serrulate, presenting a sharp cutting edge. Inflorescence 24 by 19 mm. appearing as one very dense head of numerous spikelets as if composed of 3 congested spikes, slightly reddish in colour. Bracts up to 9 (some appearing from within the inflorescence) similar to the leaves spreading and ultimately drooping, lowest 34.5 cm. by 6 mm., upper portion scabrous along the veins, margins serrulate like the leaves, tips finely acuminate. Spikelets 8 mm. long by 1.7 mm., angular, bearing 2 nuts, disarticulating below the lowest fertile flower in one piece. Glumes all with red glandular dots; the lowest empty glume broadly elliptic, 7-nerved, 2 by 1.5 mm., tip rounded, margins membranous, incurved in the lower half; upper empty glume ovate-lanceolate, 9-nerved, 3 mm. long (including the arista), tip bilobed with a short or long arista in the sinus, margins incurved, membranous; lowest flowering glume larger than the one above it, ovate-lanceolate, acute, 13-nerved, 6 by 2.6 mm. (opened out), margins membranous, incurved over the wings of the rhachilla; upper flowering glume elliptic-lanceolate, 13-nerved, 4.5 by 2.5 mm., tip produced into a short recurved point, margins membranous, incurved over the wings of the rhachilla. Rhachilla broadly winged, the wings together elliptic, but individually obliquely oblong, tip oblique running into the margin of the glume above, embracing the nut. Stamens 3, filaments strap-shaped, anthers oblong, not crested. Nut oblong, trigonous, puncticulate, reaching 3.5 by 1.3 mm., base of style sometimes persistent. Style, including branches, 5 mm., branches 3 mm. long.

Locality: *W. Ghats*: Mahableshwar (Nana Sedgwick's Coll. 7646 ! type).

2. **Mariscus bulbosus** C. B. Clarke in Hook. f. F.B.I. vi (1893) 620.—*Cyperus Clarkei* T. Cooke in Fl. Bomb. ii, 873.—*Kyllinga bulbosa* Koenig in Vahl Enum. ii (1806) 376 (*in nota*).

Description: Cke. l.c.

Locality: *S. M. Country*: (Woodrow 36 ex Cooke); Dharwar (Woodrow ex Cooke, Talbot 2907 !), on dry pasture, 2,400 ft., rainfall 34 in. (Sedgwick 4140 ! 6233 !); Badami (Woodrow ex Cooke).—*N. Kanara*: (Young ex Clarke).

Flowering & fruiting: August 1918 and October 1892 (Dharwar).

Distribution: S. M. Country, N. Kanara, Horsleykonda, Chingleput, Salem, Tinnevelly Dist.

3. **Mariscus paniceus** Vahl Enum. ii (1806) 373.—*Kyllinga panicea* Rottb. Descr. *et* Ic. (1773) 15, t. 4, fig. 1.—*Mariscus cyperinus* Vahl l.c. 377; C. B. Clarke in Hook. f. F.B.I. vi, 621.—*M. Sieberianus* Nees in Linnaea ix (1835) 286.—For synonyms see C. B. Clarke l.c. 620, 621, 622.

Description: Base of stem not thickened by sheaths. Roots producing stolons or not. Stolons long, scaly. Rhizome very short, nodulose, or thick, creeping, clothed in the remains of old leaf-sheaths. Stems 5-75 cm. high. Leaves shorter or longer. Bracts 3-11, 2.1-30 cm. long; umbels simple, rays 3-12; spikes sessile or peduncled, cylindric in flower. Spikelets erect or suberect or spreading at right angles, subulate or cylindric, often curved, not markedly compressed, 1-4-flowered; glumes not aristate; nut-bearing glume cuspidate or not. Spikelets bearing 1-3, rarely 4, nuts. Nuts oblong-ellipsoid, or obovate-oblong or narrowly elliptic-oblong, obtuse or with an acute apex, muricate or not, straight or curved.

A most variable plant, depending much on the habitat and fertility of the soil and on the amount of shade. The number of spikes appears to be conditioned by the growth of the individual, and so also the number of flowers in each spikelet. Spikes are found with and without branches to every degree.

This plant is so variable that to separate the Bombay material is quite a hopeless task both in the herbarium and in the field. Specimens of this plant have been obtained in one and the same locality and at the same time which could be assigned to one or the other of the above species or their varieties as given in C. B. Clarke.

It is significant that nearly all the *Umbellati* were considered by Bentham as varieties of his *Cyperus umbellatus.* It would be sounder to treat those 'varieties' as forms.

Locality: Without locality (Dalzell !).—*W. Ghats*: Igatpuri (Blatter & Hallberg 1746 ! 2800 !, McCann 2385 !); Khandala (Blatter, Hallberg & McCann 28580 !, Sedgwick 2553 !); Panchgani (McCann 2758 ! 3010 ! 3011 !, Sedgwick 7926 !), slope of Tableland (Fernandez 1745 !); foot of Tableland (McCann 2759 !); in forest below Third Tableland (McCann 2876 !); Londa, 1,600 ft. (Sedgwick 2739 !).—*Konkan*: (Law ex Cooke); Sativali Forests, Bassein, Thana (Ryan 1088 !); Parol Forest, Bassein Range (Gammie 2441 !); Sion Hill, W. slope, in gravel, under the dripping of the Cracker store house roof (Blatter & McCann 613 ! 2440 !, McCann 937 ! 940 ! 945 ! 946 ! 947 ! 948 !); Vetora (Sabnis 612 ! 33112 ! 33122 ! 33419 !); Mulgaon, Salsette (Blatter & McCann 2440 !).—*S. M. Country*: Devarayi, forests, 1,500 ft. (Sedgwick 4101 ! 4105 ! 4108 ! 4109 !); Tavargatti, sandy ground by forest, 2,000 ft., rainfall 70 in. (Sedgwick 2556 !); Badami (Bhide !); Dharwar, in shade of trees, 2,400 ft., rainfall 34 in. (Sedgwick 6211 !).—*N. Kanara*: (Talbot !, Hallberg & McCann C114 ! C115 !); Devimane Ghat, 600 ft., rainfall 250 in. (Sedgwick 6946 !); Malemani Ghat, 1,000 ft., rainfall 300 in. (Sedgwick 7204 !); Yellapur (Talbot !); Haliyal (Talbot 1884 !); Karwar (Talbot !).

Flowering & fruiting: May 1918 (Vetora); July 1883 (Karwar); July 1917 (Sion, Tavargatti, Khandala, Mulgaon); July 1918 (Devarayi); July 7th, 1925 (Panchgani); July 26th, 1904 (Parol); July 28th, 1930 (Panchgani); July 30th, 1903 (Sativali); August 1887 (Karwar); August 1917 (Londa); August 1919 (Dharwar); August 2nd, 1884 (Haliyal); August 16th and 25th, 1930 (Panchgani); August 25th, 1929 (Sion); August 31st, 1930 (Panchgani); September 1917 (Igatpuri); September 8th, 1911 (Badami); October 1917 (Igatpuri); October 1919 (Malemani, Devimane); October 1921 (Panchgani); October 10th, 1884 (Yellapur).

Field notes: Stems 3-gonous, highly polished, stiff, dark green, inclined at an angle, not upright. Rhizome black, hard. Spikelets pale green, becoming straw-coloured on drying, fragile.

A monsoon species, but the rhizome is perennial, usually growing at the margins of forests or in the shade of trees or rocks. Flowering in July.

The rhizomes are hard and woody. The internodes are very short; the nodes appearing close together give the rhizome an annulated appearance.

Distribution: Throughout India.—Warm regions of the Old World.

4. **Mariscus konkanensis** Sedgwick in Journ. Bomb. Nat. Hist. Soc. xxv (1918) 698.—*Cyperus konkanensis* T. Cooke in Fl. Bomb. Pres. ii, 874.

Description: Cke. l.c.

Locality: Without locality (Dalzell, H.I.F.I.).—*W. Ghats*: (Woodrow 34 ex Cooke); Khandala (Bhide 15417 !); Purandhar Fort (Blatter & McCann 5572 !, Bhide !); Mahableshwar, grassy bank in forest, S. side of plateau (Sedgwick 4617 !); Fitzgerald Ghat, common (McCann 2974-2978 ! 3410 !).—*Deccan*: Kirkee, Mr. Gammie's compound (Garade 556 ! very likely cultivated); Singhar (Garade 62 !).

Flowering & fruiting: July 21st, 1902 (Kirkee); July 30th, 1902 (Singhar); August 28th, 1930 (Fitzgerald Ghat); September 7th, 1907 (Purandhar); September 20th, 1902 (Khandala); September 24th, 1930 (Fitzgerald Ghat); November 1919 (Mahableshwar); December 1917 (Purandhar).

Field notes: A very characteristic species, and easily recognized by its habit. Growing in dense tufts on the hillside of Mahableshwar. The rhizomes give off bunches of blackish tubers at intervals. Inflorescence pale, almost straw-coloured even in the fresh state. Grows on steep banks at the margin of the forests bordering on the Fitzgerald Ghat Road and also on the cliffs and overhanging rocks where sufficient earth has accumulated. Commences to flower about the middle of August. The old stems of the preceding year are frequently to be seen with the new. During the dry season the plant dries up completely. The spikelets in fresh condition are stiff and spreading. The leaves are paler beneath.

Distribution: W. Ghats, Deccan.—So far endemic.

Though this species has been called '*Konkanensis*' by Cooke, it seems very evident that it does not occur in the Konkan. Cooke described the species from a single specimen obtained by Woodrow and probably labelled in a careless way 'Konkan' without any other definite locality. From our own observations this species does not descend far beyond the 5-mile limit down the Fitzgerald Ghat which goes to indicate that it does not go down to the plain or to a low elevation.

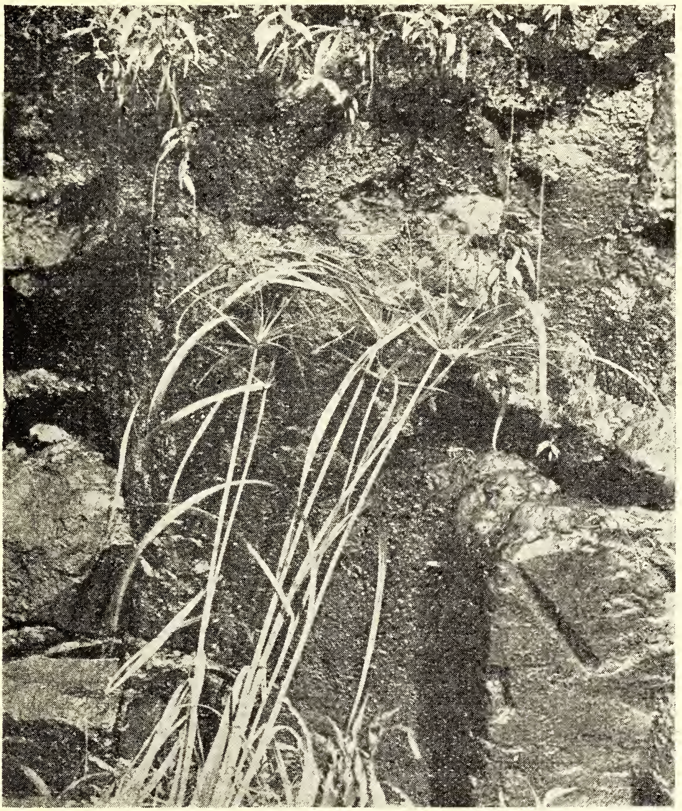


Photo *C. McCann*

Mariscus konkanensis Sedg.

5. **Mariscus pennatus** Domin in Biblioth. Bot. lxxxv (1915) 440.—*Cyperus pennatus* Lam. Ill. i, 144; Cke. ii, 875.—*C. canescens* Vahl Enum. ii, 355 (*excl. syn.* Rheede).—*Mariscus albcscens* Gaud. in Freyc. Voy. Bot. 415.

Description: Cke. l.c.

Locality: *W. Ghats*: Lonavla (Woodrow ex Cooke, Herb. E.B.B. !).—*Konkan*: (Cooke, Paranjpye 168 ! several sheets of the same number labelled 'Konkan'); Murdi, near Aiyala, seacoast, just near highwater mark (Paranjpye !); Mahad (Woodrow ex Cooke).

Flowering & fruiting: March 1926 (Konkan); November 16th, 1926 (Murdi).

Distribution: From Bengal to Ceylon and Singapore, tropical Africa, Mascarene Islands, S.-E. Asia, Malaya, Australia, Polynesia.

6. **Mariscus compactus** Druce in Rep. Bot. Exch. Cl. Brit. Isles 1916, 634 (1917).—*M. microcephalus* Presl. Rel. Haenk. i (1830) 182.—*Cyperus compactus* Retz. Obs. v (1789) 10.—*C. spinulosus* Roxb. Fl. Ind. i (1832) 203.—*C. dilutus* Vahl Enum. ii (1806) 357; Cke. ii, 875.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Cooke).—*W. Ghats*: Castle Rock (Gammie 15529 !).—*Konkan*: (Herb. St. X.C. 3127 !); Bombay Reclamation S.-W. of

Churchgate Station[1] (McCann !); Andheri (McCann !); Jungar Hills, Thana (Paranjpye !); Mahad (Woodrow !); near Malad, in a ditch along railway line (McCann 1341-1344 !).—*S. M. Country*: Devikop, in a pool (Sedgwick 1900 !); marshes near Alnavar, 2,000 ft. (Sedgwick 2916 !).—*N. Kanara*: Siddhapur, 1,600 ft., rainfall 100 in. (Sedgwick 7022 !); Yellapur, bank of a tank (Talbot 1024 !).

Flowering & fruiting: September 1917 (Alnavar); September 29th, 1929 (near Malad); October 1919 (Siddhapur); October 24th, 1902 (Castle Rock); October 30th, 1907 (Thana); November 1916 (Devikop).

Field notes: A tall, tufted, stiff looking plant with long thick arching leaves. The umbels are large with chocolate-brown spikelets, turning reddish on drying and in herbarium material. The leaves have sharp serrulate margins which cut readily.

A plant inhabiting marshes and ditches and other wet places. Purely a monsoon species and one of the latest to come into flower—about the middle of September.

Distribution: Throughout India, 0-3,000 ft.—Mauritius, China, Malaya.

6. Courtoisia Nees (Cke. ii, 877).

Species 2.—Tropical Asia, Africa.

1. **Courtoisia cyperoides** Nees in Linnaea ix (1835) 286; Benth. in Hook. Ic. Pl. (1880) t. 1341; Cke. ii, 877.—*Kyllinga cyperoides* Roxb. Fl. Ind. i (1832) 182.—*Mariscus cyperoides* Dietr. Sp. Pl. ii, 348.

Description: Cke. l.c.

Locality: *Konkan*: (Law ex Cooke).—*S. M. Country*: Hulkop, Dharwar Dist., 2,000 ft., rainfall 40 in. (Sedgwick 3451 !); Havasbhavi, water holes, 1,800 ft., rainfall 33 in. (Sedgwick 1973 !); Dastikop, 2,500 ft., rainfall 35 in. (Sedgwick 2080 !); fairly common in Maval tract (Sedgwick).—*N. Kanara*: Gersoppa Falls, 1,400 ft., rainfall 200 in. (Herb. Sedgwick & Bell 7153 !); Yellapur (Talbot 1563 !).

Flowering & fruiting: October 1919 (Gersoppa); October 10th, 1884 (Yellapur); December 1916 (Dastikop); December 1917 (Hulkop; Havasbhavi).

Distribution: From Sikkim and Assam to Pegu, Konkan, S. M. Country, N. Kanara, Coorg, Mysore, Nilgiris, Malabar, Carnatic.—Madagascar, tropical Africa.

7. Eleocharis R. Brown (Cke. ii, 887).

Species 90.—Cosmopolitan.

Key after Cooke.

A. Glumes subrigid, smooth, striate, concolorous; stems usually stout; stigmas 2-3
  I. Nut smooth; stems terete, transversely septate when dry ... ... 1. *E. plantaginea.*
  II. Nut longitudinally striate; stems subtriquetrous below the spikelet, not septate
    1. Spikelets acute; glumes ovate, subacute . 2. *E. fistulosa.*
    2. Spikelets obtuse; glumes quadrate, rounded or subtruncate ... ... 3. *E. spiralis.*
B. Glumes membranous, usually 1-3-nerved, with a green keel; stems usually slender ...
  I. Stigmas 2, not compressed ... ...
    1. Roots fibrous; rhizome short or 0
      a. Bristles glistening, white ... ... 4. *E. atropurpurea.*
      b. Bristles brown or rusty ... ... 5. *E. capitata.*
    2. Rhizome creeping; bristles rusty-brown ... 6. *E. palustris.*
  II. Stigmas 3
    1. Nut prominently trabeculate ... ... 7. *E. Chaetaria.*
    2. Nut smooth ... ... 8. *E. congesta.*

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[1] This species has in all probability been introduced from Salsette along with the earth used for filling in.

1. **Eleocharis plantaginea** R. Br. Prodr. (1810) 224 (*in nota*); Cke. ii, 888.—*Scirpus plantaginus* Roxb. Fl. Ind. i (1832) 212.—*Scirpus plantaginoides* Rottb. Descr. *et* Ic. (1773) 45, t. 15, fig. 2.

Description: Cke. l.c.

Cooke in the clavis distinctly states that the glumes are keeled, but in the description he contradicts this by saying that the glumes are not keeled.

Locality: Bombay, without locality (Herb. Kew ex Cooke).—*Sind*: (Pinwill ex Cooke).—*Gujarat*: Dansura tank, N. Modasa (Sedgwick 1071 !); Prantij (Saxton 2927 !); Baroda (Woodrow ex Cooke, Herb. Col. of Sc. Pa. now in Cal. !).—*Konkan*: Varol Tank, Bhivandi, near Kalyan (McCann 1696 !).—*S. M. Country*: Bomigatti, tank, Dharwar Dist., 2,000 ft., rainfall 35 in. (Sedgwick 3829 !).—*N. Kanara*: Hattikeri, Karwar, in a tank (Herb. Sedgwick & Bell 6768 !, Hallberg & McCann C13 !); Karwar (Sedgwick 6678 !, Hallberg & McCann C14 ! C15 ! C91 !, Talbot !).

Flowering & fruiting: March 1918 (Bomigatti); August 1890 (Karwar); September 1915 (Dhansura); October 1919 (Hattikeri, Karwar); October 26th, 1930 (Bhivandi).

Field notes: 'In a few inches of water on the margin of the Bokh. Gregarious over a few square yards. Not seen elsewhere. Heads light brown.' (Saxton).

At Varol Tank, we found this species occupying large areas both in deep and shallow water. So dense were the groups that the stems were interlaced. Few specimens were in flower at the time (October 26th, 1930) as the water level was still very high. Stem terete, striate, and of a bluish green.

Distribution: N.-W. India, Assam, Sind, Gujarat, Konkan, S. M. Country, N. Kanara, Mysore, Coimbatore, Carnatic, Travancore.—Ceylon, Malay Peninsula, tropics of the Old World.

2. **Eleocharis fistulosa** Link. in Spreng. Jahrb. Gewächs. (1820) Heft 3, 78; Cke. ii, 888.—*Heleocharis fistulosa* Boeck. in Linnaea xxxvi (1870) 472.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 626.

Description: Cke. l.c.

Cooke states that the bristles are longer than the nut, Clarke figures them as such (Ill. of Cyp.), and in Hooker the bristles are said to be shorter than the nut. We find them longer than the nut.

Locality: *W. Ghats*: Panchgani, Tableland (McCann & Fernandez 1729-1734 !); Castle Rock (Bhide !).—*S. M. Country*: Bomigatti, Dharwar Dist., in a tank 1,800 ft., rainfall 35 in. (Sedgwick 3826 !); Badami (Bhide !).—*N. Kanara*: Yellapur (Talbot 1040 !).

Flowering & fruiting: March 1918 (Bomigatti); September 8th, 1911 (Badami); October 1909 (Castle Rock); October 1st, 1884 (Yellapur); November 22nd, 1930 (Panchgani).

Field notes: In Panchgani we observed the plants in a monsoon pool on the Tableland associated with *Scirpus corymbosus*, in August. The stems were tufted, purplish below but otherwise of a dull green colour. The specimens did not flower till after the middle of November. The soil was soft sticky clay.

Distribution: From Nepal and Assam to Burma, W. Ghats, S. M. Country, N. and S. Kanara, Mysore.—Ceylon, Tropics generally.

3. **Eleocharis spiralis** R. Br. Prodr. (1810) 224 (*in nota*); Cke. ii, 888.—*Scirpus spiralis* Rottb. Descr. *et* Ic. (1773) 45, t. 15, fig. 1.

Description: Cke. l.c.

Locality: *Konkan*: Bassein (Blatter & McCann 2358 !); Bombay (Blatter & Hallberg Sedgwick's No. 3473 !); Sion (Blatter & McCann 2731 !); Salsette (Jacquemont 725 ex Cooke).—*Goa* (Lisboa 45 ex Cooke).—*N. Kanara*: Karwar (Talbot !).

Flowering & fruiting: August 1885 (Karwar); September 1917 (Sion); November 1916 (Sion).

Distribution: Bengal, Burma, Konkan, N. Kanara, Goa, Carnatic.—Ceylon, Mauritius, Cochin-China.

4. **Eleocharis atropurpurea** Kunth Enum. ii (1837) 151; Cke. ii, 889.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Cooke).—*Gujarat*: Ahmedabad, nala near Watraj (Sedgwick 293 !); Godra (Woodrow ex Cooke).—*W. Ghats*: Igatpuri

(Blatter & Hallberg 3204 ! 5141 !); Khandala (Blatter & McCann 1740 !).—*Konkan*: Parel (Blatter & McCann 3218 !); Sion (Blatter & McCann 3070 ! 1989 !); Kalyan (Woodrow or Cooke H.E.B.B. !).—*N. Kanara*: Karwar, rice fields (Sedgwick 6718 !, Hallberg & McCann C87 !); Kumpta, rice fields (Talbot !).

Flowering & fruiting: January 1917 (Igatpuri); August 1917 (Parel); September 1914 (Wadaj); September 4th, 1895 (Kalyan); October 1919 (Karwar); November 1916 (Sion); December 10th, 1883 (Kumpta).

Distribution: W. Himalaya, Assam, Sind, Rajputana, Gujarat, Konkan, W. Ghats, S. and N. Kanara, Carnatic.—Ceylon, Tropics generally.

5. **Eleocharis capitata** R. Br. Prodr. (1810) 225; Cke. ii, 889.

Description: Cke. l.c.

Locality: *Sind*: (Dalzell ex Cooke); Jamadar ka Landa (Stocks ex Cooke).—*Gujarat*: Godhra (Woodrow).—*Khandesh*: Bor, Tapti River, sandy mud (Blatter & Hallberg 3224 !); Dhulia, Noti tank (Chibber !).—*W. Ghats*: Mahableshwar (Chibber !); Londa (Gammie !).—*Deccan*: Poona (Woodrow ex Cooke, Kelkar !), riverside (Bhide 24 !); Mangri, near Poona (Gammie 15348 !); Nira Canal, Poona Dist. (Chibber !); Chinchwad (Woodrow or Cooke ?, H.E.B.B. !); Trimbak (Chibber 416 !).—*Konkan*: Pen (Blatter, Hallberg & McCann 3228 !); Bandra, sandy shore (Vakil C90 !).—*S. M. Country*: Hubli (Sedgwick 4907 !); Devarayi, 1,800 ft., rainfall 90 in. (Sedgwick 4480 !); Bagalkot, riverbank (H.E.B.B. !).—*N. Kanara*: (Thomson ex Cooke); Karwar, seashore (Sedgwick 5051 ! 5103 !); mouth of Kala Nuddi River (Hallberg & McCann C89 !); Kumpta, rice fields (Talbot !).

Flowering & fruiting: February 1917 (Pen); March 14th, 1908 (Nira Canal); March 20th, 1908 (Mahableshwar); April 16th, 1906 (Bagalkot); May 1900 (Londa); May 8th, 1902 (Poona); July 1919 (Bandra); August 17th, 1902 (Mangri); September 20th, 1895 (Poona); September 29th, 1895 (Chinchwad); October 1918 (Devarayi); October 1919 (Kala Nuddi); November 1894 (Godhra); November 30th, 1907 (Trimbak); December 1916 (Bor); December 1918 (Hubli, Karwar); December 10th, 1883 (Kumpta); December 27th, 1907 (Dhulia).

Distribution: Bihar, Bengal, throughout the Bombay and Madras Pres., Singapore.—Ceylon, most warm countries.

6. **Eleocharis palustris** R. Br. Prodr. (1810) 224 (*in nota*); Cke. ii, 890.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Clarke); Hyderabad (Woodrow ex Cooke).

Distribution: From the W. Himalaya, ascending to 12,500 ft., to Sind and Bengal.—Cosmopolitan except Australia.

7. **Eleocharis Chaetaria** Roem. & Schult. Syst. ii (1817) 154; Cke. ii, 890.

Description: Cke. l.c.

Locality: *W. Ghats*: Castle Rock (Gammie 15738 !); Londa (Herb. Col. of Sc. Pa. now in Cal. !, Woodrow ex Cooke).—*Konkan*: Vetora, near stream (Sabnis C86 !).—*S. M. Country*: Dharwar (Woodrow ex Cooke).—*N. Kanara*: 30 miles E. of Karwar, rivulet by road (Sedgwick 6570 !); marshes at Supa (Sedgwick 4861 !); Sirsi to Siddhapur (Hallberg & McCann C85 !); Kadra, banks of Kala Nuddi (Talbot 1316 !).

Flowering & fruiting: October 1919 (Sirsi to Siddhapur, E. of Karwar); October 10th, 1889 (Kadra); October 27th, 1902 (Castle Rock); November 1918 (Supa); December 1919 (Vetora).

Distribution: More or less throughout India.—Ceylon, Malacca, Tropics generally.

8. **Eleocharis congesta** Don Prodr. 41.—*Scirpus congestus* Spreng. Syst. Cur. *post.* 27.—*Eleocharis purpurascens* Boeck. in Linn. xxxvi, 455.

Description: A caespitose sedge 20-30 cm. high with slender nearly terete 8-10-fluted or -striate stems and a terminal many-glumed ovoid or conical spikelet 5-7.5 mm. long, frequently with subsidiary branches from the axil of the bract which may bear a smaller spikelet. Glumes 2 mm. ellipsoid-oblong, concave, not keeled, hyaline in centre and with often coloured margins or a coloured band between the centre and margins, midrib very fine. Stigmas 3, longer than the short style. Nut straw-coloured, 1.25 mm. without or 1.5 mm. with the narrow-conical style-base, obovoid or pyriform, obscurely 3-angled. Bristles rather stout, a little longer than nut, retrorsely scabrous.

Locality: *S. M. Country*: Devarayi, in rice fields, 1,800 ft., rainfall 90 in. (Sedgwick 4421 !).

Flowering & fruiting: October 1918 (Devarayi).

Distribution: Kashmir, Nepal, Chota Nagpur, S. M. Country, Nilgiris and Pulney Hills, 5,000-7,000 ft.—Ceylon.

8. FIMBRISTYLIS Vahl. (Cke. ii, 878).

Species 225.—Chiefly tropical.

A. *Eleocharoides.* Stem with 1 spikelet. Glumes not distichous (occasionally 1-3 spikelets in *F. polytrichoides; see also F. schoenoides*)
  I. Nut narrowly elongate, cylindric, curved ... 1. *F. tetragona.*
  II. Nut obovoid, biconvex, with 6-8 very deep transverse corrugations ... ... 2. *F. acuminata.*
  III. Nut elegantly obovoid with almost obcordate apex, biconvex, minutely subtuberculately dotted ... ... 3. *F. polytrichoides.*
B. *Dichelostylis.* Spikelets more than one. Style bifid. Ovary and fruit compressed, biconvex
  I. Spikelets 1-3, rarely up to 5, large, ovate, pale, glistening ... ... 4. *F. schoenoides.*
  II. Spikelets more than 5 in fully grown individuals
    1. Spikelets in a capitate head ... ... 5. *F. argentea.*
    2. Spikelets umbelled
      a. Small tufted annuals
        † Nut smooth ... ... 6. *F. aestivalis.*
        †† Nut ribbed and trabeculate ... 7. *F. dichotoma.*
      b. Taller
        † Glumes obtuse with hyaline margins and tips. Nut dark, not ribbed or trabeculate ... ... 8. *F. spathacea.*
        †† Glumes mucronulate, glabrous. Nut pale, ribbed and trabeculate ... 9. *F. annua* var. *diphylla.*
        ††† Spikelets large, dark red-brown. Glumes usually pubescent in upper half. Nut pale, smooth ... ... 10. *F. ferruginea.*
C. *Trichelostylis.* Spikelets more than one. Style 3-fid. Ovary and fruit trigonous
  I. Spikelets in a capitate head, white ... 11. *F. digitata.*
  II. Spikelets not capitately arranged
    1. Small annuals
      a. Nut white, trabeculate ... ... 12. *F. Woodrowii.*
      b. Nut white, yellow or grey, tuberculate 13. *F. tenera.*
    2. Medium or tall
      a. Base of stem thick, rhizomatous, leaves short, pungent, crowded, a denizen of grassland ... ... 14. *F. junciformis.*
      b. Not as a
        † Stem triquetrous above, glumes obtuse ... ... 15. *F. miliacea.*
        †† Stem 4-5-angled above, glumes acute ... ... 16. *F. quinquangularis.*
        ††† Stem flattened above, lowest bract broad, quite erect ... ... 17. *F. complanata.*
D. *Abildgaardia.* Lower glumes of the spikelet distichous or subdistichous. Style 3-fid ... 18. *F. monostachya.*

1. **Fimbristylis tetragona** R. Br. Prodr. (1810) 226; Cke. ii, 879.—*F. cylindrocarpa* Boeck. in Linnaea xxxvii (1871) 7.

Description: Cke. l.c.

Locality: Without locality (Dalzell in Herb. Kew ex Cooke).—*W. Ghats*: Igatpuri (Blatter & Hallberg 2846 ! 3208 ! 3216 !, McCann 2379 !); Tringalwari, near Igatpuri (Blatter & Hallberg 1968 !); Khandala (Blatter & McCann 3153 ! 5317 !, McCann 344 ! 381 ! 382 !), marshes (Sedgwick 2550 !), in a ditch near the station (McCann 404 !); Lonavla (Chibber !); Londa (Gammie ! & 15839 !).—*Deccan*: Between Nadsur and Pali (Gammie 16046 !); Hirdosi (Woodrow ex Cooke); Mawal (Woodrow ex Cooke).—*Konkan*: (Stocks ex Cooke); Karanja Isl. (Boivin 782 ex Clarke); Salsette (Jacquemont 747 ex Cooke); Lower Parel (Blatter & McCann 4252 !); Kalyan (Herb. St. X.C. 3121 !); Oservira, Mokhada, Thana Dist. (Ryan 189 !); Kankeshwar Hill, Alibag (Bhide !); Mulland, in a marsh (McCann 820 !); foot of hills W. of Mulland, in a puddle (McCann 891 ! 894 !).—*S. M. Country*: Devarayi, 1,800 ft., rainfall 90 in. (Sedgwick 4461 !); Bidi, Belgaum Dist., 2,500 ft., rainfall 50 in. (Sedgwick 3020 !); Havasbhavi, fields, 2,000 ft., rainfall 33 in. (Sedgwick 1942 !); in a nala near Yelvigi, Dharwar Dist., 2,000 ft., rainfall 30 in. (Sedgwick 1904 !); Badami (Bhide !).—*N. Kanara*: (Law ex Cooke); Karwar (Hallberg & McCann C48 ! C49 !), edges of rice fields (Talbot 1306 !), common in rice fields (Talbot 1507 !); Jog to Siddhapur (Hallberg & McCann 35089 !).

Flowering & fruiting: March 1917, March 1929, April 1929, June 1917 and July 1916 (Khandala): August 11th, 1929 (Mulland, and foot of hills W. of Mulland); August 25th, 1885 (Karwar); September (Kalyan); September 1917 (Igatpuri, Bidi to Belgaum); September 8th, 1911 (Badami); October 1917 (Igatpuri); October 1918 (Devarayi); October 1919 (Karwar, Jog to Siddhapur); October 4th, 1907 (Lonavla); October 6th, 1899 (Londa); October 7th, 1919 (Lonavla); October 10th, 1910 (Alibag, Kankeshwar Hills); October 16th, 1891 (Londa); October 17th, 1902 (Oservira); November 1916 (Yelvigi); November 1st, 1917 (Igatpuri); November 2nd, 1902 (Londa); December 1916 (Havasbhavi); December 9th, 1902 (Nadsur to Pali).

Field notes: Purely a monsoon species which may occasionally be met with in and near marshes throughout the year. The monsoon forms are decidedly larger than those obtained during the dry season. The stems are greenish covered with a whitish or grey powdery substance—tufted, terete. The heads are pale when young in the monsoon form and become brown when mature. Flowering commences in early July in the monsoon forms and after the rains are over the plants die down.

Distribution: Throughout India, except the N.-W.—Ceylon, E. Asia, Australia.

2. **Fimbristylis acuminata** Vahl Enum. ii (1806) 285; C. B. Clarke in Hook. f. F.B.I. vi, 631.—*Scirpus scaber* Roxb. Fl. Ind. i (1832) 220.

Description: Stems 10-30 cm., slender, obscurely quadrangular, leafless, uppermost sheath produced on one side, 0-12 mm. Spikelet one, erect, lanceolate, 12-18 mm. Glumes ovate, scarcely mucronate, pale or chestnut with green keel; lowest 2-3 empty, much shorter than spikelet. Stamens usually 2. Style nearly as long as nut, flattened, slightly villous at top; branches shorter than style. Nut as long as $\frac{1}{3}$-$\frac{1}{2}$ glume, biconvex, with 4-7 strong transverse ridges.

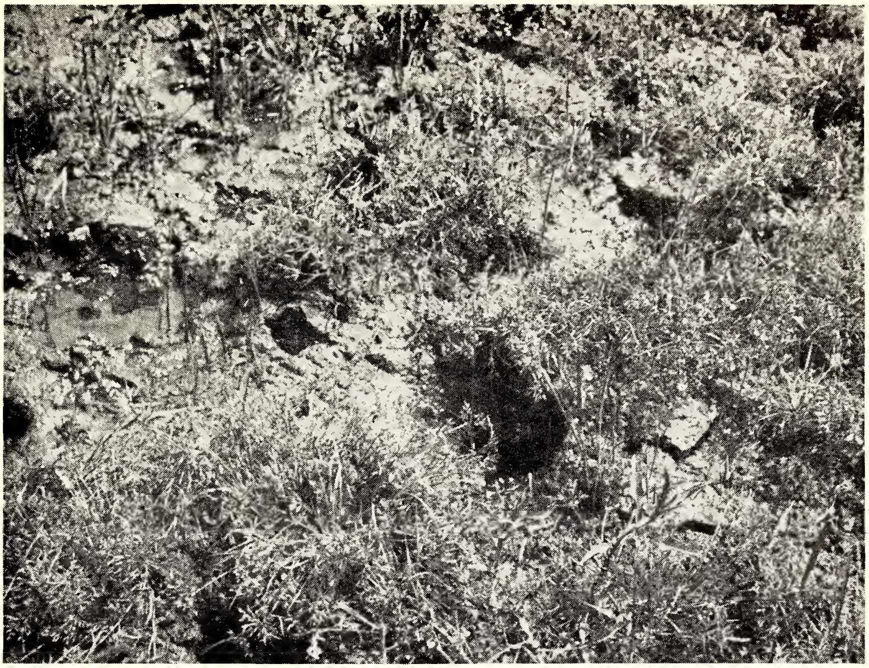
Locality: Without locality (Dalzell !).—*S. M. Country*: Devarayi, 1,800 ft., rainfall 90 in. (Sedgwick 4422 !).—*N. Kanara*: Karwar (Hallberg & McCann C55 !), sandy rice fields by the sea (Sedgwick 5101 !); in a marsh, 30 miles E. of Karwar (Sedgwick 6561 !); Yellapur (Talbot !).

Flowering & fruiting: September 1895 (Yellapur); October 1918 (Devarayi); October 1919 (Karwar); December 1918 (Karwar).

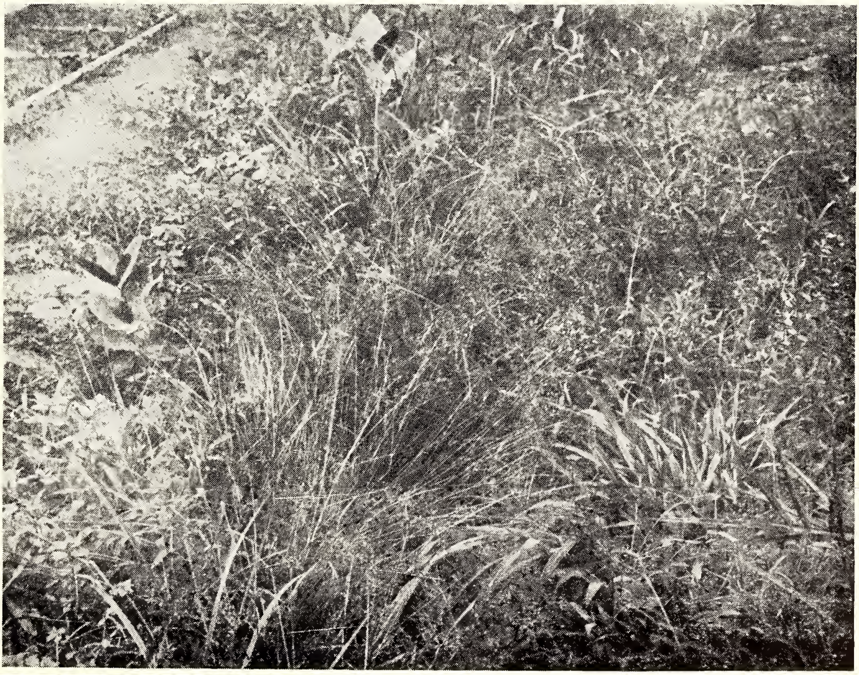
Distribution: Throughout India, 0-3,500 ft., from Kumaon and Assam to Ceylon and Malacca, S. M. Country, N. and S. Kanara, Mysore, Travancore.

3. **Fimbristylis polytrichoides** R. Br. Prodr. (1810) 226; Cke. ii, 879.—*F. juncea* Boeck. in Linnaea xxxvii (1871) 4 (*non* Roem. & Schult.).

Locality: *Konkan*: Bombay, seashore (Herb. Sedgwick & Bell 7316 !), seaface near Mahalaxmi Battery (McCann 354 !), Antop Hill (Blatter & McCann 2450 !); Sion (Blatter & McCann 2370 ! 2726 !, Woodrow ex Cooke); in a marsh near the station (McCann 965 !); Bandra, seashore (Vakil C130 !); Kalyan (Woodrow ex Clarke).—*N. Kanara*: Karwar (Hallberg & McCann C50 !

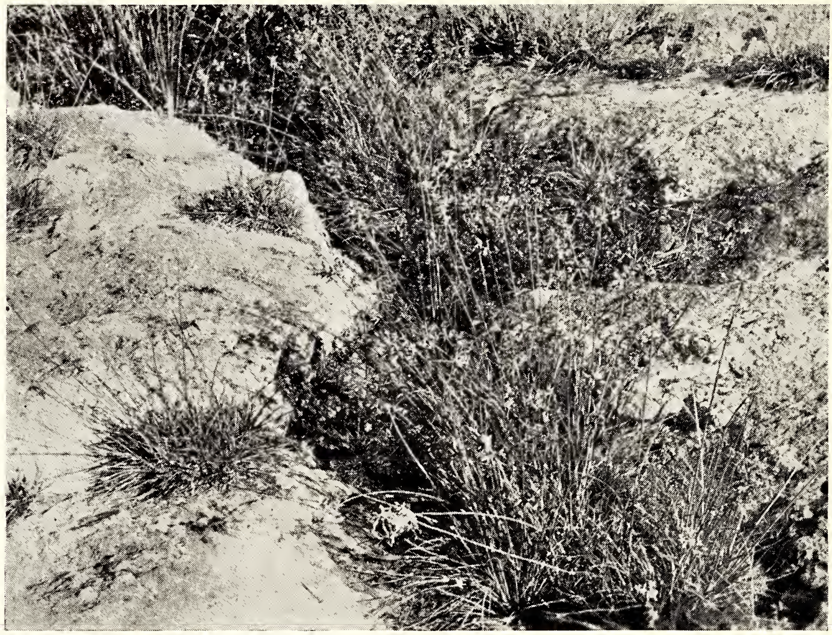


Fimbristylis dichotoma Vahl in a marsh at Khandala, W. Ghats.



Fimbristylis miliacea Vahl in a puddle near the Vihar Lake, Salsette Island.

Photos by C. McCann.



Fimbristylis spathacea Roth. growing on rocks at Maval, Rajputana.

Fimbristylis digitata Boeck. on well drained slope at Mulland, Salsette Island.

Photos by C. McCann.

C52 !), seaface (Sedgwick 6710 !, Talbot !); mouth of the Kala Nuddi River (Hallberg & McCann C51 !).

Flowering & fruiting: March 23rd, 1929 (Bombay); June 1917 (Sion); August 1917 (Antop Hill); August 20th, 1885 (Karwar); August 25th, 1929 (Sion); September 25th, 1892 (near Sion); October 1919 (Karwar); November 1916 (Sion); December 1919 (Bombay).

Field notes: A plant of the seashore and saline marshes, forming densely tufted rosettes, partially prostrate, often radiating from the centre. The general flowering season seems to be the monsoon, but it may be found in flower at any time in the marshes.

Distribution: From Bengal to Ceylon and Malacca, Konkan, N. Kanara, E. coast from Godavari southwards, near the sea.—Tropics of the Old World.

4. **Fimbristylis schoenoides** Vahl Enum. ii (1806) 286; Cke. ii, 880.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 634.

Description: Cke. l.c.

Locality: Without locality (3 sheets H.E.B.B. !).—*Sind*: (Pinwill ex Cooke).—*Gujarat*: Talod, red earth upland (Sedgwick 274 !, Saxton 365 !); Dhansura, Modasa Petha, Ahmedabad Dist., damp ground (Sedgwick !).—*W. Ghats*: Khandala (Woodrow ex Cooke; Blatter, Hallberg & McCann 3036 !; Saxton 1204 !), St. Xavier's Villa (McCann C57 !).—*Konkan*: (Woodrow ex Cooke); Kanari Caves, Salsette (Blatter & McCann 2439 !); Mulgaon, Salsette (Blatter & McCann 2444 !); foot of the hills W. of Mulland, in open ground (McCann 809 !); Vickroli, foot of hills W. of Railway Station, in open ground (McCann 1026 !).—*S. M. Country*: Bidi, Belgaum Dist., in water, 2,500 ft., rainfall 60 in. (Sedgwick 2963 ! 3021 !).—*N. Kanara*: (Hallberg & McCann C54 !); Karwar, hillside (Herb. Sedgwick & Bell 6693 !); Yellapur (Talbot 1507 !).

Flowering & fruiting: July 1916 (Khandala); July 1917 (Mulgaum); August 1914 (Dhansura, Talod); August 1917 (Kanari Caves); August 11th, 1929 (Mulland); August 25th, 1929 (Vickroli); September 1895 (Konkan); September 1917 (Bidi to Belgaum); September 1919 (Khandala); October 1919 (Kanara, Karwar); October 10th, 1884 (Yellapur); October 12th, 1915 (Khandala).

Field notes: Purely a monsoon species, growing in open land. In Salsette we have observed this species forming close carpets intermixed with *Rhyncospora Wightiana* and young grass (*Manisuris* ?). Isolated specimens are also to be met with in open grassland. Flowering commences soon after the break of the rains (about the end of June). A weak-stemmed species with brown polished spikes. When growing in grass it is soon overtopped and apparently disappears. The more or less globose heads and polished glumes readily distinguish it from *F. tetragona* which it closely resembles.

Distribution: Throughout India.—Ceylon, China, Malaya, Australia.

5. **Fimbristylis argentea** Vahl Enum. ii (1806) 294; Cke. ii, 881.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 640.

Description: Cke. l.c.

Locality: Without locality (Dalzell !).—*Gujarat*: Sonasan, by a small bank (Sedgwick 327 !).—*N. Kanara*: Mouth of Kala Nuddi River (Hallberg & McCann C66 !); Karwar (Talbot 1313 !), sandy fields by the sea (Sedgwick 5090 !).

Flowering & fruiting: October 1914 (Sonasan); October 1919 (Kala Nuddi River); December 1918 (Karwar).

Distribution: Bengal, Central India, Gujarat, N. Kanara, Mysore, Cuddapah, Chittor, Nilgiris, Malabar, Travancore, Tinnevelly.—Ceylon, Mauritius.

6. **Fimbristylis aestivalis** Vahl Enum. ii (1806) 288; Cke. ii, 881.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 637.

Description: Cke. l.c.

Fischer (Flora of Madras, p. 1658) has united this species with *F. dichotoma* Vahl. Though these two plants do look alike to a certain extent, they are really two different species and we should like them to remain as such. In the field they very often grow together and are easily picked out. The nut is certainly a good character in the herbarium and once familiar with the plants in the field they are also easily distinguished in the herbarium. *F. aestivalis* may also be recognized in the field by its general habit and finer glaucous leaves. It is usually smaller.

Locality: Without locality: (Dalzell !).—*W. Ghats*: Khandala (McCann 1866 ! 1867 ! 3190 !, Blatter & McCann 3175 ! 3177 !, Talbot 4796 !), very common (McCann !), in a marsh near station (McCann 391 ! 392 !); Lonavla (Gammie 16312 ! 16284 !), bed of Lake (Saxton 1497 !); Matheran (Birdwood, Woodrow ex Cooke); Castle Rock, on sand-bank of Duski River (McCann C60 ! Herb. Sedgwick & Bell 5533 !).—*Deccan*: Mawal (Woodrow ex Cooke).—*Konkan*: (Woodrow Herb. !); Bhandup (Blatter & McCann 2411 !); Pen (Blatter, Hallberg & McCann 3215 ! 3250 ! 3248 !); Eastern shore of Vehar Lake, common (McCann 647 !); base of Kanari Caves (McCann 1591 !). —*Goa*: Dudhsagar Falls, Goa frontier (McCann 65 !).—*S. M. Country*: Konankeri, Dharwar Dist. (Sedgwick 4963 !); Devarayi, 1,800 ft. (Sedgwick 4033 !).—*N. Kanara*: (Hallberg & McCann 3124 !, Law ex Cooke); Karwar (Bell 3936 !); Danoli, Amboli Ghat (Gammie 15065 !); Gersoppa Falls (Chibber !); Vincholi (Talbot 943 !); Dandeli (Talbot 2270 !); Palla, south of Mundgod (Herb. Woodrow !).

Flowering & fruiting: January 11th, 1890 (Dandeli); February 1917 (Pen); February 25th, 1929 (Kanari Caves); March 1918 (Khandala); March 1919 (Castle Rock, Dudhsagar); March 31st, 1929 (Khandala); April 4th, 1884 (Vincholi); April 25th, 1906 (Khandala); May 1917 (Khandala); May 1918 (Vetora); May 1st, 1902 (Danoli); May 13th, 1903 (Lonavla); May 17th 1911 (Gersoppa Falls); May 24th, 1916 (Lonavla; bed of lake); June 1918 (Devarayi); July 1917 (Bhandup); July 7th, 1929 (Vehar Lake); December 1918 (Konankeri).

Field notes: On damp sandy places it often forms small rosettes composed mostly of the spikes (inflorescence).—A plant evenly distributed in the Presidency with the exception of the extreme North.

Distribution: More or less throughout India.—S. and E. Asia, Australia.

7. **Fimbristylis dichotoma** Vahl Enum. ii (1806) 287; Cke. ii, 880.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 637.

Description: Cke. l.c.

Locality: Without locality (Dalzell !).—*Sind*: (Stocks ex Cooke); Hyderabad (Chibber !).—*Kathiawar*: Porbandar (Janalekar !).—*Gujarat*: Bodeli (Woodrow !, Blatter 3122 !); Dangs, S. Gujarat (Bell 5440 !); Kabir Vad, Broach (Chibber 772 !, Gammie !); Nadiad (Chibber 251 !); Surat (Gammie 16444 !); Sevalia (Chibber 515 !); Vasvad (Chibber !); in bed of stream under Gorair Bridge, Chitrasani to Sarotra (McCann 1400 !).—*Khandesh*: Bhusawal, N.-E. Tapti River (Blatter & Hallberg 1926 !); Bor, Tapti River, sandy mud (Blatter & Hallberg 3017 !); Nimb, Tapti bank (Blatter & Hallberg 1932 !); Talner, Tapti bank (Blatter & Hallberg 3020 ! 3022 !); Chanseli, N. slope, Taloda (Blatter, Hallberg & McCann 29576 !).—*W. Ghats*: Khandala (Woodrow ex Cooke), in marsh near station (McCann 342 ! 345 ! 385 !), very common (McCann !, Blatter & McCann 3152 !); Lonavla (Gammie 16284 !); Purandhar (Blatter & McCann 5588 !); Panchgani (Blatter & Hallberg B1739 !).—*Deccan*: Sangli, river-bank (Blatter C61 ! C62 ! C63 !); Varavandi, Ahmednagar Dist. (Herb. Sedgwick & Bell 7378 !); Kali (Gammie 15124 !); Poona, riverside (Bhide 2 !); on banks of Nira River (Fernandez C174 ! C186 !).—*Konkan*: (Dalzell-Lambert, Stocks ex Cooke); Pen (Blatter, Hallberg & McCann 3214 !); Mulgaon, Salsette (Blatter & McCann 2445 !); to Karjat (Blatter & Hallberg 3179 !); Vetora (Sabnis 33299 !); Hills W. of Tulsi Lake, in a stream (McCann 355a ! 355b ! 355c !).—*S. M. Country*: Bagalkot, riverbank (H.E.B.B. !); Dharwar Dist., ricefields, very abundant (Sedgwick 2339 !); Sangli, riverbank (Blatter C176 !).—*N. Kanara*: Yellapur (Talbot !); Vincholi (Talbot !).

Flowering & fruiting: January 1917 (Bhusawal, Pen); January 22nd, 1925 (Sangli); February 1919 (Dangs); February 1920 (Varavandi); March 1884 (Yellapur); March 1917 (to Karjat, Khandala, Dharwar Dist.); March 7th, 1929 (Nira River); March 24th, 1929 (Tulsi Lake); March 29th, 1929 (Khandala); April 1884 (Vincholi); April 1917 (Khandala); April 1918 (Karwar); April 5th, 1909 (Hyderabad); April 17th, 1906 (Bagalkot); April 19th, 1909 (Porbandar); May 1914 (bed of Sabarmati); May 1917 (Khandala); May 3rd, 1903 (Lonavla); May 8th, 1902 (Poona); May 16th, 1902 (Karli); July 1917 (Mulgaum); September 1914 (Wadaj); October 24th, 1929 (Chitrasani to Sarotra); October 29th, 1903 (Surat); November 21st, 1907 (Nadiad); December 1916 (Bor, Nimb); December 1917 (Purandhar); December 1918 (Chanseli); December 3rd, 1907 (Sevalia); December 20th, 1904 (Kabir Vad); December 29th, 1911 (Vasvad).

Field notes: The curious point about this species is that it is mostly concentrated in the drier or Northern parts of the Presidency as is seen from the available material with occasional finds in the Konkan, S. M. Country and Kanara. In the Deccan it is perhaps the commonest plant of the marshes, along river-banks and watercourses throughout the year. It grows in dense rosettes and is extremely prolific. It is very often mixed with *F. aestivalis* which it closely resembles. It grows equally well in soft sticky soil, on sand and among rocks, often attaining a large size when in the two latter situations. Specimens taken in the bed of a watercourse among rocks where sand had collected measured 41.5 cm. whereas the Floras give 25 cm. as the maximum. The specimen referred to was taken in April 1929 and is in McCann's herbarium.

This plant closely resembles *F. aestivalis* as has been mentioned before, but in the field is easily distinguished from it by the colour, as *F. aestivalis* is more inclined to be greyish green. There is a slight difference in the form of the umbel but this is difficult to describe and can be made out only by the practised eye.

'Common on sand and on the Red Soil plateau, Talod. Roots of plants collected by the Khari River are noted as very highly aromatic.' (Saxton & Sedgwick Pl. N. Guj. R.B.S.I. vi, 307).

Distribution: Throughout India, especially in rice fields.—Ceylon, warm regions of the Old World.

8. **Fimbristylis spathacea** Roth Nov. Pl. Sp. (1821) 24; Cke. ii, 882.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 640.

Description: Cke. l.c.

Clarke identified Talbot's Karwar specimen No. 551 as *F. aestivalis* in Herb. Calc. We cannot agree.

The Mirpur Sakro specimen was determined as *F. dichotoma* by B. N. Vakil in the Flora of the Indus Delta.

Locality: Sind: (Pinwill ex Cooke); Karachi (Woodrow ex Cooke); Landhi, near Karachi (H.E.B.B. !); Mirpur Sakro (Blatter & McCann D736 !).—*Gujarat:* Loamy and salt encrusted valleys, not uncommon (Saxton and Sedgwick); marshes on the Dhansura, Talod Road (Sedgwick !); nala near Wadaj, marshy ground (Saxton 1822 !); in sandy bed of stream under Gorair Bridge, Chitrasani to Sarotra (McCann 1402 ! 1402a !).—*Konkan:* Uran, Bombay Harbour (Hallberg & McCann 2745 !); Versova, in marsh (Blatter & McCann 29573 !); Bassein (Paranjpye !); Bandra (Wroughton !).—*S. M. Country:* Riverbed, Dharwar Dist. (Sedgwick 2329 !).—*N. Kanara:* Karwar (Talbot 551 !, Hallberg & McCann C69 ! C70 !), sandy seashore (Sedgwick 6674 !); Sulgeri, Kala Nuddi (Bell 4236 !).

Flowering & fruiting: January 1917 (Uran); July 1918 (Versova); July 20th, 1883 (Karwar); August 1914 (Dhansura); August 1918 (Sulgeri); August 9th, 1912 (Bassein); August 16th, 1919 (Wadaj); October 1919 (Karwar); December 1918 (Landhi).

Field notes: A densely tufted species with stiff leaves and stems usually growing on river and tank banks and in crevices of rocks in the same situations.

Distribution: Orissa, Bombay Pres., near the sea on both coasts of the Madras Pres., N. Coimbatore.—Ceylon, Singapore. Warm regions.

9. **Fimbristylis annua** Roem. & Schult. Syst. ii, 95, **var. diphylla** Kükenthal.—*F. diphylla* Vahl Enum. ii (1806) 298; Ckei. ii, 882.—*Scirpus annuus* Allioni Fl. Pedem. ii, 171, t. 88, f. 5.

Description: Cke. l.c.

There is a depauperate specimen in the H.E.B.B. from Bhandala (September 24th, 1895) determined as *F. diphylla* var. *annua* R. & S. We do not think it justifiable to make a variety of such a specimen, as the condition may have something to do with the locality in which the specimen was growing —probably very poor soil. The specimen measures 11.5 cm. whereas the Floras give 15-60 cm.

C. B. Clarke in F.B.I. vi, 636 has 'Nut 5-13-striated on each face', further on in the description he writes: 'Nut . . . smooth.' We have found the nut of the specimens obtained from Salsette, particularly the larger ones, having the shoulders tuberculate and very obscurely striate.

Locality: *Sind*: (Pinwill ex Cooke).—*Gujarat*: Talod, red earth upland (Sedgwick 270 !, Saxton 357 !); near Talod (Sedgwick !); Dhansura, Modasa Petha (Sedgwick !).—*W. Ghats*: Igatpuri (Blatter & Hallberg 2811 ! 2817 !); Khandala (Blatter, Hallberg & McCann 3047 ! 3060 !, McCann C80 ! 372 !); Panchgani, Tableland (Blatter & Hallberg B1740 ! B1741 !, McCann 2981 !); Castle Rock, 1,600 ft., rainfall 250 in. (Sedgwick 2740 ! 2824 !); Londa (Gammie 14071 !).—*Deccan*: Ganeshkhind Gardens (Garade !).—*Konkan*: (Stocks, Woodrow ex Cooke); Bassein (Blatter & McCann 2353 !); Vehar Lake, Salsette (Blatter & McCann 2761 !); Vetora (Sabnis 33102 ! 33429 !); Wada Taluka, Thana Dist. (Ryan 693 ! 694 !); Salarwady (Woodrow or Cooke (?) H.E.B.B. !); Sion Hill (McCann 961 !); Mulland, in a marsh W. of village (McCann 812 !); foot of hills W. of Mulland, in open (McCann 890 !); hills W. of Vickroli Station (McCann 1024 !); E. shore of Vehar Lake, by a stream (McCann 638 ! 654 !).—*S. M. Country*: Dharwar, in a water-hole, 2,400 ft., rainfall 35 in. (Sedgwick 6199 !); Devarayi (Sedgwick 4046 !).—*N. Kanara*: Karwar, by a stream (Sedgwick 6603 !, Talbot 601 !, Hallberg & McCann C68 !); Gersoppa Falls, on rocks in riverbed (Hallberg & McCann C84 !).

Flowering & fruiting: March 31st, 1929 (Khandala); May 1918 (Vetora); May 25th, 1900 (Londa); June 1918 (Devarayi); June 13th, 1902 (Ganeshkhind); July 1917 (Khandala); July 7th, 1929 (Vehar Lake); August 1883 (Karwar); August 1914 (Talod, near Talod, Dhansura); August 1917 (Castle Rock); August 1919 (Dharwar); August 11th, 1929 (Mulland); August 25th, 1929 (Sion, Vickroli); September 1902 (Wada Taluka); September 1917 (Igatpuri, Bassein, Devikop); September 1919 (Khandala); September 20th, 1902 (Khandala); September 24th, 1895 (Bhandala); October 1919 (Karwar, Gersoppa Falls); October 1920 (Panchgani); November 1916 (Vehar Lake).

Field notes: Generally speaking this is a monsoon species. A most variable plant growing in the open, and the margins of forests. We have noticed that those specimens which grow in open land mixed with other plants are weak and small, with few spikes, sometimes reduced to one, the nut and glumes being also smaller, compared with those from the margins of forests.

Distribution: Throughout India, up to 6,000 ft.—All warm regions.

9a. **Fimbristylis annua** Roem. & Schult. **var. paucispiculata** Blatter & McCann.—*F. diphylla* var. *annua* C. B. Clarke in Hook. f. F.B.I. vi, 637.

Locality: *W. Ghats*: Khandala (Sedgwick 2588 !), St. Mary's Villa grounds (McCann C82 !).—*Deccan*: Nasik, Lena Hill (Blatter & Hallberg 1537 !).—*Konkan*: Antop Hill, Bombay (Blatter & McCann 2426 !); Trombay (Blatter & McCann 33856 !); Mulgaon, Salsette (Blatter & McCann C59 !).—*S. M. Country*: Devikop, in grass in forest clearing (Sedgwick 2975 !).

Flowering & fruiting: July 1917 (Mulgaon); August 1917 (Antop Hill); September 1917 (Lena Hill, Trombay); September 1919 (Khandala).

Distribution: Bengal, Deccan, Konkan, S. M. Country.

10. **Fimbristylis ferruginea** Vahl Enum. ii (1806) 291; Cke. ii, 881.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 638.

Description: Cke. l.c.

Cooke says: 'Leaves 0 or few', some of the specimens are decidedly leafy at the base. 'Spikelets $\frac{3}{8}$ by $\frac{1}{8}$ in.'—in one specimen obtained in Kanara they measure 18 by 5 mm.

The hairiness of the upper half of the glumes is a good distinguishing character.

Locality: *Sind*: (Pinwill ex Cooke).—*Cutch*: Karu Roa (Blatter 1974 !). —*Gujarat*: Gogha, in tank (Chibber 312 !); road to Lasundra (Chibber 460 !); red earth upland, near Talod (Sedgwick 255 !, Saxton 309 !); in sandy bed of stream under Gorair Bridge, Chitrasani to Sarotra (McCann 1398 !).—*Khandesh*: Bori River (Blatter & Hallberg 2732 !); Amalner, Bori River (Blatter & Hallberg 2758 !).—*W. Ghats*: Khandala station (Blatter & McCann 3001 !); Bhor Ghat (Herb. St. X.C. 3123 !); Panchgani, Dalkeith

Springs (McCann 3489 !); Pasarni Ghat (McCann 3039 !).—*Deccan*: Gangapur, Nasik (Blatter & Hallberg 2839 ! 4539 !); Poona (Blatter 3125 !, Clarke !, H.E.B.B., Cooke, Woodrow ex Cooke), Ganeshkhind Gardens (Patwardhan !, Garade 434 !); Nira Canal, Poona Dist. (Chibber !); Pashan (Paranjpye !); Mangri, near Poona (Gammie 15345 !); Happy Valley, near Ahmednagar (Paranjpye !); Ahmednagar to Parner Road (Paranjpye !).—*Konkan*: (Talbot 528 ex Clarke); Bombay (Jacquemont 412, ex Clarke), Antop Hill (Blatter & McCann 2423 !); Bandra (Vakil C67 !); Bassein (Chibber !, Blatter & McCann 2354 !); Hills E. of Tulsi Lake, in a stream (McCann 356a ! 356b ! 356c !).—*S. M. Country*: Tegur, Dharwar-Belgaum Road (Sedgwick 5503 !); Dharwar, 2,400 ft., rainfall 34 in. (Herb. Sedgwick & Bell 4989 !); Yelvigi, Dharwar Dist., 1,800 ft., rainfall 30 in. (Sedgwick 2111 !).—*N. Kanara*: Sadashivgad, sands (Bell 7801 !); Karwar, salt marshes (Sedgwick 5100 !); Kala Nuddi at Sulgeri (Bell 4445 !); Kumpta (Chibber !).

Flowering & fruiting: February 1919 (Tegur); March 13th, 1911 (Happy Valley); March 14th, 1908 (Nira Canal); March 24th, 1929 (hills E. of Tulsi Lake); June 13th, 1902 (Ganeshkhind); August 1914 (Talod); August 1917 (Antop Hill, Bandra, Khandala); August 9th, 1905 (Ganeshkhind); September 1917 (Gangapur, Bassein); September 1918 (Kala Nuddi); September 13th, 1907 (Happy Valley); September 21st, 1907 (Ahmednagar to Parner); September 26th, 1895 (Poona); October 23rd, 1914 (Pashan); October 24th, 1929 (Chitrasani to Sarotra); November 1st, 1910 (Kumpta); November 29th, 1907 (Gogha); December 1907 (Karu Roa); December 1916 (Yelvigi, Bori River); December 1918 (Dharwar, Karwar, Dadgaon); December 1920 (Sadashivgad); December 2nd, 1907 (Road to Lasundra).

Field notes: In our experience a plant inhabiting the banks of rivers, streams and tanks—sandy soil being preferred. Under these conditions it flowers throughout the year when there is sufficient water.

Distribution: Throughout India.—Ceylon, China, Japan, Malaya, Australia, Polynesia.

11. **Fimbristylis digitata** Boeck. in Flora lxi (1878) 35; Cke. ii, 884.

Description: Cke. l.c.

Locality: *W. Ghats*: Khandala (Blatter, Hallberg & McCann 3052 !, Sedgwick 2595 !, Blatter 1858 !, McCann 1857 ! 3194 ! 3220 !); Lonavla (Garade !, Woodrow ex Cooke).—*Konkan*: (Dalzell, Stocks and Law ex Cooke); Khanoli (Herb. St. X.C. 33561 !); Bhandup to Vehar Lake, very common on open gravelly ground (McCann 648 !); hillsides near Ghatkopar (Sedgwick 1028 !); hills W. of Mulland (McCann 1650 !).—*S. M. Country*: Badami (Woodrow 56 ex Cooke).—*Goa*: Marmagao (Talbot 2506, ex Cooke).—*N. Kanara*: (Law ex Cooke); Belekerry (Talbot 491 ! 1182 !).

Flowering & fruiting: May 1917 (Khandala); May 1918 (Khanoli); June 1892 (Lonavla); June 7th, 1916 (Lonavla); June 10th, 1883 (Belekerry); June 15th, 1885 (Belekerry); June 24th, 1903 (Lonavla); July 1915 (Ghatkopar); July 1916 (Khandala); July 7th, 1929 (Bhandup to Vehar Lake); July 8th, 1902 (Lonavla); August 1908 (Khandala); August 17th, 1889 (Belekerry).

Field notes: An extremely common species growing in open ground on gently sloping hillsides and plateaux on well drained soil usually consisting of gravel or pebbles. Frequently occupying large areas 'apparently' to the exclusion of other plants. This is due to the fact that this species appears soon after the break of the monsoon when the grass with which it is mixed grows slower. As soon as the plants have fruited they 'disappear' as they are usually lost in the longer grasses. They commence to flower soon after the beginning of the rains and disappear as fast.

This species is very conspicuous with its white spikelets arranged in a head at the summit of the usually short filamentous stem and is easily recognized by this character both in the field and in the herbarium from any of the other *Cyperaceae* in the Presidency.

The plants have a thick black tuberous rhizome which persists—hence it should be classed as a perennial. The period of activity of a single plant is barely 2 months.

Distribution: Deccan, Konkan, N. Kanara.—Endemic.

12. **Fimbristylis Woodrowii** C. B. Clarke in Journ. Linn. Soc. xxxiv (1898) 68; Cke. ii, 884.

Description: Cke. l.c.

Locality: *W. Ghats*: Igatpuri (Blatter & Hallberg 2809 !); Khandala (Woodrow ex Cooke, Sedgwick 2576 !, McCann 3185 !, Blatter, Hallberg & McCann 3002 !, H.E.B.B. !, Woodrow (?) H.E.B.B. !); Castle Rock (Sedgwick 2732 ! 2733 !, Bell 4320 ! 4355 !).—*Konkan*: Malvan (Woodrow ex Cooke).—*N. Kanara*: Karwar (Hallberg & McCann C75 !, Talbot 999 !); roadside E. of Karwar (Sedgwick 6567 !).

Flowering & fruiting: March 1917 (Khandala); May 1917 (Khandala); July 1917 (Khandala); August 1883 (Karwar); August 1916 (Khandala); August 1917 (Castle Rock); September 1917 (Igatpuri); September 1918 (Castle Rock); September 1919 (Khandala); September 24th, 1895 (Khandala); October 1918 (Karwar; E. of Karwar); October 1919 (Karwar).

Distribution: W. India.

13. **Fimbristylis tenera** Roem. & Schult. Syst. ii, Mant. 57.—*F. monticola* Hochst. ex Steud. Syn. Pl. Cyp. (1855) 111; Cke. ii, 885.

Description: Annual, glabrous, except the glumes. Stem slender, 20 cm. long. Leaves half the length of the stem, 1.25-2 mm. broad. Umbel loose, subcompound, of 7-10 solitary spikelets; bracts 2-3, setaceous, shorter than the umbel. Spikelets ellipsoid-lanceolate, nearly 6 mm. long, 2 mm. broad, 10-flowered. Glumes ovate, acuminate, submucronate, boat-shaped, adpressed, glandular-puberulous, chestnut-red, keel yellow, margins conspicuously scarious. Style 3-fid, longer than the nut, deciduous together with its pyramidal base, glabrous. Nut hardly half the length of the glume, obovoid, round-trigonous, white or pallid, coarsely reticulate, smooth or sometimes subtubercled.

Locality: Without locality (Dalzell !).—*Gujarat*: Ahmedabad, nala near Wadaj (Sedgwick 292 !); red earth upland near Talod (Sedgwick 241 !).—*Khandesh*: Talner, Tapti River (Blatter & Hallberg 1859 !); Bor, Tapti bank (Blatter & Hallberg 3013 ! 3023 ! 4453 !); Nimb, Tapti River (Blatter & Hallberg 1930 !).—*W. Ghats*: Khandala (Blatter, Hallberg & McCann 3042 ! 3051 ! 3055 ! 3063 ! 3065 !); Lingmala, on rocks (McCann 3411 ! 3416 !); Panchgani, slope of Tableland (McCann 2806 !).—*Deccan*: Shelarvadi, Bhor Ghat (Woodrow 10 ex Cooke).—*Konkan*: Antop Hill, Bombay (Blatter & McCann 2425 !); Pen (Blatter, Hallberg & McCann 3213 ! 3237 !); Nanjri, Narsery Forest (Ryan 1177 ! 1178 !).—*S. M. Country*: Badami Hills (Paranjpye !).

Flowering & fruiting: January 1917 (Pen); March 1917 (Khandala); July 1916 (Khandala); August 1914 (near Talod); August 1917 (Antop Hill); August 8th, 1906 (Manjri, Nursery Forest); August 18th, 1930 (Panchgani); September 1914 (Wadaj); September 1919 (Khandala); September 1st, 1912 (Badami Hills); September 24th, 1930 (Lingmala); December 1916 (Talner, Bor, Nimb).

Distribution: Throughout Bombay Pres., S. Kanara, Mysore, Bellary, Chingleput, Nilgiris, Anamalais, Travancore.—Ceylon, tropical Africa.

14. **Fimbristylis junciformis** Kunth Enum. ii (1837) 239; Cke. ii, 886.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 647.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Cooke).—*Gujarat*: Talod, dry place on red earth upland (Sedgwick 282 !, Saxton 376 !).—*Deccan*: Karli (Woodrow ex Cooke).—*Konkan*: Mulgaon, Salsette (Blatter & McCann 2408 ! 2446 !); Bandra (Wroughton !).—*S. M. Country*: Devikop, openings in deciduous forest, Dharwar Dist., 1,800 ft., rainfall 40 in. (Sedgwick 3983 !); Dharwar, 2,400 ft., rainfall 34 in. (Sedgwick 2545 !, Talbot !).—*N. Kanara*: (H.E.B.B. !).

Flowering & fruiting: May 1918 (Devikop); June 1883 (N. Kanara); June 1917 (Dharwar); July 1917 (Mulgaon); August 1893 (Dharwar); August 1897 (Bandra); August 1914 (Talod); August 10th, 1890 (Dharwar).

Distribution: Throughout India.—Ceylon, Madagascar, Philippines.

15. **Fimbristylis miliacea** Vahl Enum. ii (1806) 287; Cke. ii, 883.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 644.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Clarke).—*Gujarat*: Baroda (Blatter 3120 !, Herb. Woodrow !); Grassy path between rice fields, 4 miles N.-W. of Ahmedabad (Sedgwick 312 !).—*W. Ghats*: Khandala (Blatter, Hallberg & McCann

3050 ! 3059 !, McCann 3193 !, Sedgwick 2575 !), in a marsh (McCann 352 !). —*Konkan*: (Lambert ex Cooke); Bhandup (Blatter & McCann 2417 ! C73 !); Trombay (Blatter & McCann 33857 !); Vetora (Sabnis 33596 !); Tungar Hills, Thana (Paranjpye !); E. shore of Vehar Lake, in a stream (McCann 651 ! 652 !); Borivli to Kanari Caves, margin of a tank (McCann 1110 !), in rice fields (McCann 1162 !); Kalyan (Woodrow ex Cooke).—*S. M. Country*: Devarayi (Herb. St. X.C. C74 !); Havasbhavi, 1,800 ft., rainfall 35 in. (Sedgwick 1986 !); Dastikop, high rice fields, 2,500 ft., rainfall 35 in. (Sedgwick 1859 !).—*N. Kanara*: Karwar (Talbot 1304 !), sandy fields by the sea (Sedgwick 5097 !); Yellapur (Talbot !).

Flowering & fruiting: January 1919 (Bhandup); March 1919 (Dudhsagar Falls); March 31st, 1929 (Khandala); May 1917 (Khandala); May 1918 (Vetora); June 1917 (Bhandup); July 1916 (Khandala); July 7th, 1929 (Vehar Lake); September 1917 (Trombay); September 4th, 1896 (Kalyan); September 10th, 1895 (Karwar); September 15th, 1929 (Borivli to Kanari Caves); October 1902 (Castle Rock); October 1914 (4 miles N.-W. of Ahmedabad); October 5th, 1884 (Yellapur); October 30th, 1907 (Thana); November 1910 (Kanara Dist.); November 1916 (Dastikop); December 1916 (Havasbhavi); December 1918 (Karwar).

Field notes: Almost entirely a monsoon species, but may be found near or in water at any time of the year. The small spikelets and the characteristically flattened basal portion of the stem are good field characters which easily distinguish this species. Habit tufted—gregarious.

Distribution: Throughout India, up to 6,000 ft.—All warm regions.

16. **Fimbristylis quinquangularis** Kunth Enum. ii (1837) 229; Cke. ii, 883. —Synonyms in C. B. Clarke in Hook. f. F.B.I. vi, 644.

Description: Cke. l.c.

Locality: Without locality (Dalzell !).—*Sind*: Chunar, Indus River (Blatter & McCann C183 !).—*Gujarat*: Modasa Petha, marshy banks of Watrak River (Sedgwick 1059 !); Ahmedabad, rice fields (Sedgwick 311 !); Kharagoda (Saxton !); Baroda (Woodrow ex Cooke).—*W. Ghats*: Igatpuri (Blatter & Hallberg 2843 !, McCann 2387 !); Khandala (Blatter & McCann 3170 !, Sedgwick 2573 !), in a marsh near the station (McCann 388 !); Lonavla (H.E.B.B. !); near Shivapur village (Fernandez C175 !); Castle Rock (Gammie !).—*Konkan*: (Law ex Cooke); Bombay (Boivin 987 ex Clarke); Mahim (Blatter & McCann 2729 !); Bassein (Blatter & McCann 2357 !); Andheri (Blatter & McCann 3085 !); Bhandup, near tank (Blatter & McCann 2744 !); Versova (Ryan 1369 !); Mulland, in a marsh W. of village (McCann 821 !); Borivli to Kanari Caves, in open ground near a puddle (McCann 1126 !); along railway line near Malad (McCann 1350 !); Kalyan (H.E.B.B. !). —*S. M. Country*: Devarayi, 1,800 ft., rainfall 30 in. (Sedgwick 4097 ! 4464 !); Alnavar, 2,000 ft., rainfall 40 in. (Sedgwick 2923 !).—*N. Kanara*: Sampkhand (Hallberg & McCann C71 ! C72 !); roadside E. of Karwar (Sedgwick 6568 !); 30 miles E. of Karwar (Sedgwick 6569 !); Yellapur (Talbot 986 !).

Flowering & fruiting: March 1917 (Khandala); March 29th, 1929 (Khandala); July 1917 (Khandala); July 1918 (Devarayi); August 11th, 1929 (Mulland); August 22nd, 1929 (near Shivapur); September 1884 (Yellapur); September 1915 (Watrak); September 1917 (Igatpuri, Bassein, Alnavar); September 15th, 1903 (Versova); September 15th, 1929 (Borivli to Kanari Caves); September 29th, 1929 (Malad); October 1914 (Ahmedabad); October 1917 (Igatpuri); October 1918 (E. of Karwar, Devarayi); October 1919 (Sampkhand, 30 miles E. of Karwar); October 11th, 1914 (Kharagoda); November 1916 (Mahim, Bhandup); December 1916 (Andheri).

Distribution: More or less throughout India.—Ceylon, Malay Peninsula, Malaya, China, Australia.

17. **Fimbristylis complanata** Link Hort. Berol. i (1827) 292; Cke. ii, 886. —For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 646.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Cooke).—*Gujarat*: Watrak River banks, Modasa Petha (Sedgwick 1060 !); Talod, damp ground on red earth upland (Sedgwick 253 !).—*Khandesh*: Dhulia (Chibber !).—*Deccan*: Gangapur, Nasik (Blatter & Hallberg 2838 !); near Chattersinghi (Ranade ex Cooke); Poona

(H.E.B.B. !, Clarke !).—*W. Ghats*: Lonavla (Blatter, Hallberg & McCann 2492 !).—*S. M. Country*: Shiggaon, Dharwar Dist., in a cocoanut garden, 2,000 ft., rainfall 30 in. (Sedgwick 3661); Yelvigi, Dharwar Dist. (Sedgwick 4282 !).

Flowering & fruiting: February 1918 (Shiggaon); August 1914 (Talod); August 1918 (Yelvigi); September 1896 (Poona); September 1915 (Watrak); September 1917 (Gangapur, Lonavla); December 28th, 1907 (Dhulia).

Distribution: Throughout India in the warm region.—All warm regions.

Var. microcarpa C. B. Clarke in Hook. f. F.B.I. vi, 446.

Locality: *Deccan*: Poona (Woodrow ex Cooke); water-hole at Hewra (Dalzell ex Cooke).

Distribution: Kumaon, up to 8,000 ft., Sikkim, Bombay.—E. Asia, Australia.

18. **Fimbristylis monostachya** Hassk. Pl. Jav. Rar. (1848) 61; Cke. ii, 885.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 649.

Description: Cke. l.c.

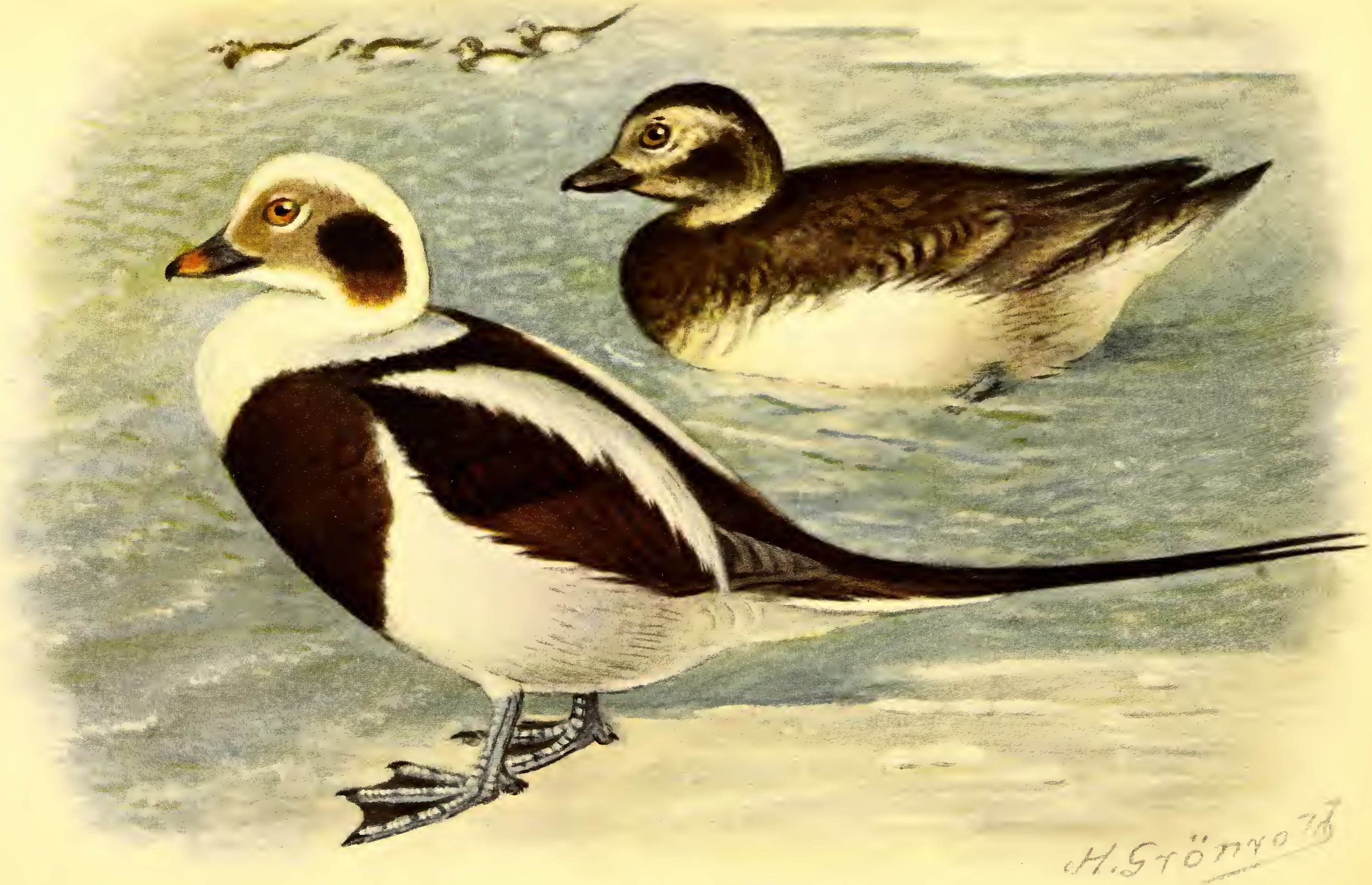
Locality: Without locality (Dalzell !).—*Sind*: (Pinwill ex Clarke).—*Gujarat*: Dhansura, Modasa Petha, damp ground (Sedgwick 249 !).—*Deccan*: Gangapur, Nasik (Blatter & Hallberg 2804 !); Poona (Jacquemont 411 ex Cooke, Herb. St. X.C. 3118 !, Herb. Woodrow !).—*Konkan*: Bandra (Wroughton !); on open plain between the hills W. of Vickroli (McCann 1020 !); foot of hills W. of Mulland (McCann 807 !).—*S. M. Country*: Dharwar, 2,400 ft., rainfall 34 in. (Sedgwick 2688 !), dry hills (Sedgwick 2950 !), stony ground (Talbot 2502 !); Badami (Woodrow ex Cooke).—*N. Kanara*: Karwar (Hallberg & McCann C58 !); Yellapur (Talbot !).

Flowering & fruiting: June 27th, 1893 (Badami); July 1897 (Bandra); July 1917 (Dharwar); July 10th, 1891 (Dharwar); August 1914 (Dhansura); August 11th, 1929 (Mulland); August 25th, 1929 (Vickroli); rainy season (Yellapur); September 1917 (Gangapur, Poona); September 12th, 1895 (Poona); October 1917 (Karwar).

Field notes: Purely a monsoon species. Usually growing in open ground. Forming dense rosettes. Spikes pale green, slightly polished. Isolated specimens filamentous.

Distribution: Throughout warmer India.—All warm regions.

(To be continued).



THE LONG-TAILED DUCK
Clangula hyemalis.
½

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THE LONG-TAILED DUCK.

BY

E. C. STUART BAKER, C.I.E., F.Z.S., F.L.S.,
M.B.O.U., H.F.A.O.U.

(*With a coloured plate*).

GLANQULA HYEMALIS.

The Long-tailed Duck.

Anas hyemalis Linn. Syst. Nat., 10th ed., vol. i, p. 126, 1758, N. Europe and America. (Restricted to Sweden.)

Description.—Adult male, Winter. A white ring round the eye; posterior ear-coverts, extending to the neck in a broad band, chocolate brown, tinged with chestnut-buff next the neck; chin, throat and foreneck joined to a broad ring round the hind neck and extreme upper back pure white; sides of face and crown grey with narrow white ring next the bill and merging into the white hind neck on the crown; back, rump, upper tail-coverts and central two pairs of tail-feathers chocolate brown; outermost tail-feathers white, the next two pairs with a little brown near the centre of the tip; intermediate pairs grading between the central and outermost; long attenuated scapulars and line of innermost tertiaries pure white; lesser, median and greater coverts nearly black, slightly glossed with green; primaries brown, the shafts of the outer ones white at the base; secondaries dark and chestnut-brown on the outer webs; pale dull brown on the inner; inner secondaries blackish; whole breast and upper abdomen chocolate; abdomen, under tail-coverts and flanks pure white; axillaries and under wing-coverts dull brown; under aspect of wing-quills pale brown.

Colours of soft parts.—Iris golden orange; tip and base of bill as far forward as the anterior edge of the nostril black; intermediate portion orange red; legs, toes and a line on the web on either side of the middle toes bluish white, remainder of the webs black.

Measurements.—Wing 219 to 236 mm.; tail 199 to 246 mm.; tarsus 32 to 35 mm.; bill from feathers of forehead 26 to 29 mm. (Witherby).

Male in summer.—Centre of fore-crown and across whole hind crown, chin, throat, cheeks and nearly entire neck black, well marked with white on hind neck and to a lesser extent on foreneck; breast more black and less chocolate than in winter; scapulars and outer feathers of mantle black with chestnut-buff edges.

Colours of soft parts.—Bill black, legs and feet dull blue-grey.

Male eclipse.—Mantle darker, the black more pronounced; the sides of the body and flanks have drab or grey feathers mingled with the white.

Adult female, winter.—Forehead generally white; lores and face hair-brown; chin dusky changing to white on throat and again to dusky on lower fore-neck; remainder of head dark brown; blackish on fore-crown; upper plumage and wings brown, darker and blackish on the mantle, each feather edged with fulvous or greyish, conspicuous when fresh, but soon becoming worn and abraded; extreme upper breast and lower fore-neck brown, more or less mottled with whitish; remainder of lower parts white, axillaries and under-wing-coverts hair brown.

Colours of soft parts.—Iris yellow, yellow-brown or golden; bill greyish-black, sometimes tinged yellowish in the centre; legs and feet greenish-grey, the webs darker and with the same lines next the centre-toe as in the male.

Female, summer.—Upper parts darker and duller than in winter, the edgings to the feathers less bright and conspicuous.

Young in down.—Whole upper parts blackish, at first with rufous tips which soon become abraded; a band across the fore-neck rufescent brown; remainder of lower parts white, the posterior abdomen, vent and flanks with brown bases showing through as a dark mottling.

The bill and feet are black, the iris dark brown.

Distribution.—This very pretty little duck breeds in the far north of Asia, Europe and America. It nests freely in Iceland, the Faroes, northern Europe and Spitzbergen, being very common in northern Lapland and Russia and probably throughout northern Siberia. It also breeds in Arctic North America. In winter it migrates south to the Mediterranean, Black and Caspian Seas and the great inland lakes of Central Asia. In America it occurs at this season as far south as the northern United States and has been recorded from the Gulf of Mexico.

It has only occurred once in India, a male changing from eclipse into winter plumage having been shot by Captain A. E. L. Dredge at Chaman in British Baluchistan on 18th October of 1933.

Nidification.—Breeding so far north as this bird does it is naturally a late breeder and in northern Lapland we found that in hot years it began to breed the first week in June but in the bitter cold year of 1931 no birds had begun to lay on the 23rd June.

We found it breeding on islands, on the coast a little above high water mark, among boulders and stunted vegetation and also on the open tundra by lakes and pools and in a few instances some distance from water. One nest we found was in the centre of some juniper, about 18 in. high and at least a 100 yards from the nearest pool, a second was on a hummock standing in deep swamp, a third under a boulder among some coarse sedge, while a fourth was a hollow in the deep reindeer moss in among some stunted *Salix*. These were very typical examples of the sites chosen for the many others we found or had shewn to us. All the nests found were well hidden and invariably protected by vegetable growth of some kind or by a boulder or rock. The one we found on a hummock, referred to above, was deep in among the roots of *Salix* growing on the top of the mound and entangled with grass and weeds, so that the nest was invisible until this tangle was pulled on one side. The ducks sat very close and most of our nests were found when they rose from them within a very few yards of us; some birds got up when we were ten or fifteen yards away but others never stirred until we almost touched them, one duck sitting quite still staring at us until we actually began to move the sedge from the sides of the nest. Another duck whose nest was under some *Tamarisk* on the open tundra, instead of flying off her nest as we approached walked quitely off when we were a few yards away and stood watching us as we examined the eggs and then as quietly walked on again and nestled down on them as we stood close by her. Most ducks, when disturbed, either flew straight away or circled round once or twice and then flew off. In the latter case the duck was joined sometimes by her mate before finally disappearing. Except on such occasions we saw but little of the male near the nest unless they were on small islands when they could generally be seen on the water close by, often swimming about in company with one or two more males. When disturbed from their nests the ducks sometimes uttered a very deep short croak which is so unlike that made by any other duck that it would have sufficed to identify them, even when not seen.

The down in the nests of these ducks is very plentiful, even before incubation has advanced. Most ducks pluck but little down until incubation begins in earnest and the full supply is not placed in position until the young are about to hatch. These ducks, however, start plucking the down and lining and edging the nest with it after the first egg is laid and twice we found nests containing six fresh eggs which were fully lined and banked all round with a fine mass of down. The down is rather small, almost black and with a small pale sooty-brown centre.

The clutches of eggs are small and we found six or seven to be the usual complement while 9 was the greatest number we saw and this only once. Witherby, however, says that ten are sometimes laid. In colour the eggs are very similar to those of the Golden-Eye—an olive or greyish green, sometimes quite bright in tint. In shape, however, they differ greatly; instead of being very broad ovals they are rather long ovals, almost elliptical in shape, the small end hardly differing from the larger.

Jourdain gives the average of 130 eggs as 53.3 x 38.0 mm. maxima *59.5* x 40.0 and 57.5 x *40.5* mm.; minima *47.2* x 35.0 and 48.3 x *34.8* mm.

The average of 48 eggs measured by myself is 52.0 x 37.6 m. The male takes no part in incubation and, so far as we could see, little interest in nest, eggs or young. Even when we were working in the midnight hours we never found the drake near the nest.

Habits.—This is a sea-duck and when in flocks is often found very far from land, riding buoyantly on the roughest sea. Witherby whose experience of the bird has been vastly greater than my own, says that he has often watched it swimming about with its tail held horizontally or even 'draggling in water, when quite undisturbed'. The vast majority, however, of the birds seen by myself, more especially the drakes, held their tails rather high out of the water; many certainly held them more or less horizontally but not had them immersed. They are fine divers but do not stay as long under water as the Pochards. Three drakes which gave us a fine diving display off the island of Lunasaari stayed under water for periods of 20 to 40 seconds, the longest I timed being 48 seconds. I have never timed the females but they stay under at least as long and I think sometimes longer. Their flight is very much like that of the Pintails but not so fast though, as I have never seen them flighting or when shot at, it is hard to say that this is always so. Their voice is unlike that of any other duck known to me, a very deep guttural croak carrying to a great distance and never to be confounded with the equally deep notes of the Eider Duck, with which it is so often associated. During the breeding season it is a tame bird. The ducks, as shown above, let you walk right up to the nests before quitting while the males let you watch them fairly closely as they swim about in sea or lake. Like some other ducks, the males during the breeding season often consort in small parties of three to half a dozen. Most of these little 'club parties' wander out far to sea but some remain quite close to land, paddling and diving about just off the coast. We also saw them, though rarely, swimming in lakes and pools, generally singly.

I know nothing about what they eat but Witherby says '*Food*—mainly animal, especially mollusca; also crustacea (shrimps, small crabs, sandhoppers, etc.), *Pteropoda* and occasionally grain from wrecks. In summer fresh-water insects and their larvae including diptera (*Chirononidae* etc.), hemiptera (*corinca*). Small red worms also recorded.'

Whether or not they are good to eat themselves I cannot say as I have never eaten one but the Fins say that they are particularly tender and well flavoured.

A most interesting question in regard to the duck is its acquisition of a very largely white winter plumage. It leaves its summer quarters before the snow commences to fall although it has generally begun to acquire its white feathers. It arrives in its summer home while there is still much snow about but generally in full summer garb. The white plumage seems to have little or nothing to do with winter snows and is not paralleled with the white winter pelage and plumage of ermines, hares, ptarmigan etc. Does it mean that migration with this species is a recently acquired action, if not why the white plumage when this is of no use to it in its winter habitat, but rather the reverse.

INDIAN DRAGONFLIES.

BY

F. C. FRASER, LT.-COL., I.M.S., F.R.E.S.

PART XLII.

(*With two plates and three text-figures*).

(*Continued from page* 617 *of volume* xxxvi).

Preface.

The publication of a volume of the 'Fauna of British India' series, dealing with the superfamily *Coenagrioidea* has rendered the continuation of the present papers superfluous, as all species not hitherto dealt with in 'Indian Dragonflies', have been dealt with fully in the volume mentioned above.

Under these circumstances, an opportunity is now given to revise some of the earlier parts of 'Indian Dragonflies', the publication of which gave such a tremendous impetus to the study of Indian *Odonata.*

The monograph was started in the year 1918 at a time when both literature and material were hard to obtain and when the author himself was still on field service at the War. It is partly owing to this and partly owing to the enormous strides made since in the study of the Order that a revision of the earlier parts, dealing with the *Anisoptera,* has become so urgent a matter.

The present paper deals with the genus *Idionyx,* and serves to illustrate how great is the need for revision. Only seven species of this genus were known to science in the year 1921 when Part X of *Indian Dragonflies* was published in this *Journal*, but we now know of twenty. Of the seven species, only four were known to occur within Indian limits, but we can now list fourteen. One species has become obsolete as it has been found to be the opposite sex of an already described species, whilst, on the other hand, the male sex of another species has been found to be nonconspecific and is entirely new. Yet another species thought to belong to genus *Phyllomacromia* and afterwards transferred to genus *Idionyx*, is, in this paper, raised to generic rank under the name of *Idiophya.*

In 1921 we knew absolutely nothing about the ecology of the genus but since then, much of the life-history and habits of various species has been learnt first-hand. Nothing further need be said to stress the argument for revision.

I would like to take this opportunity to thank all those who have contributed to the compilation of the monograph, either by the gift of material or advice from specialists in the Order. More especially are my thanks due to Mr. T. Bainbrigge Fletcher, Imperial Entomologist, who was the first to come forward with offers of material, and who continued to supply me with a mass of species for over a decade. To Mr. Chas. Inglis I am also indebted for material from Darjeeling District and Sikkim, and to Col. F. Wall for large collections from Burma and Ceylon. Major Frere collected for me in the Palni Hills and Mr. H. V. O'Donel opened up a new area in the Duars, Bengal. A large collection was received from Bengal from Mr. H. Stevens, another collection from Assam came from Mr. Chas. Antram, whilst a third and very interesting lot came from Mr. Elton Bott of King Island, Mergui. To all of these collectors I tender my sincere thanks, for it is largely owing to their disinterested efforts that the dragonfly fauna of India is now so well known; the number of species in 1918 totalled only 160, but has now passed the figure of 500.

(Revision of Genus IDIONYX).

GENUS: IDIOPHYA gen nov.

Medium sized dragonflies belonging to the subfamily *Corduliinae.* Head very large, almost as large as the thorax; eyes globular, broadly contiguous;

occiput very small; frons rounded, deeply grooved; vesicle swollen, rounded at summit, simple in both sexes so far as at present known. Prothorax small, completely concealed by the overhanging head, its posterior lobe simple, thorax comparatively small, metallic, broadly marked with yellow laterally; legs rather long and slim; hind femora extending to a little beyond the end of thorax and furnished with a row of rather widely-set, very tiny spines; tibiae furnished with moderately long fine hair-like spines. Tibial keels absent in the female.

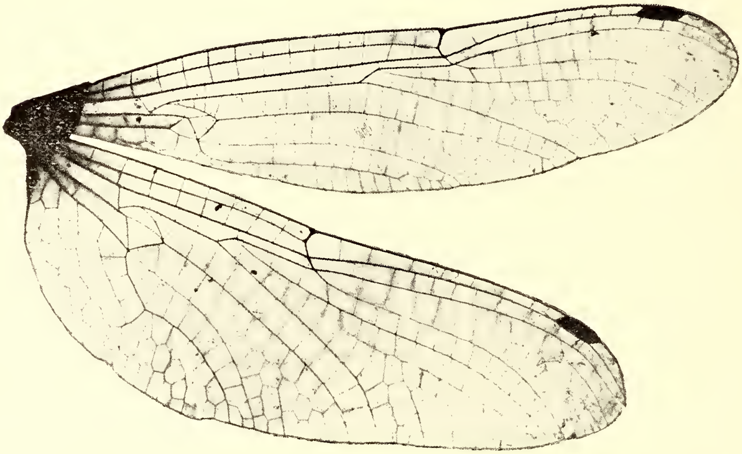


Fig. 1.—Wings of *Idiophya nilgiriensis* (Fras.) ♀.

Wings hyaline, tinted only at extreme base and variably enfumed with dull brown only in adults; reticulation moderately close, nodal index moderately high; hindwing much broader than fore; 1 cubital nervure in forewings, 2 in the hind where the subtrigone does not exist; anal loop sausage-shaped, made up of 9 to 10 cells; hypertrigone of forewing traversed once, that of the hind entire; discoidal triangles entire, *that of forewing four-sided,* the costal and distal sides usually widely separated; that of hindwing with the costal side convex and slightly longer than the basal and distal sides; subtrigone of forewing equilateral, entirely absent in the hind; discoidal field of forewing single-celled to the level of node; *Rspl* well developed in fore- and hind-wings, a single row of cells between it and *IRii; Mspl* absent; pterostigma very short, oblique at both ends, a little swollen at its middle, unbraced; membrane well developed.

Abdomen tumid at base, then cylindrical and constricted and again expanded towards the anal segments, where, in the female, it is markedly depressed; vulvar scale short, triangular, projecting but slightly from the apical end of segment 8; anal appendages of female shortly cylindrical.

Distribution.—Known only from South India and by one species which is riverine and submontane in its habits. This new genus is closely related to *Idionyx* but is more archaic and sharply differentiated by the broken character of the costal side of the discoidal triangle in the forewing, which recalls the more archaic members of the *Libellulinae* such as *Tetrathemis* or similar archaic genera of the *Corduliinae* such as *Pentathemis*, *Neophya* and *Cordulephya.* From the former it is separated by its much simpler venation, the single-celled subtrigone of forewings, only a single cubital nervure present in these wings, by the shorter anal loop and by the discoidal triangle of hindwing entire etc.; from *Neophya* it is separated by the narrower hindwing, this being enormously expanded in *Neophya;* finally from *Cordulephya,* the broader hindwing and the presence of an anal loop will serve to distinguish it, the fore and hindwings of that genus being of the same depth at base. *Idiophya* also differs from species of *Idionyx* by the shape of the abdomen which is expanded and compressed at the end in the female instead of markedly compressed and of even width as in *Idionyx;* the dorsum of segment 2 marked broadly with yellow is also foreign to *Idionyx.* Probably when the male is discovered we shall find that more characters for differentiation will be added to the above. In habits, *Idiophya* appears to be more retiring and solitary; when ovipositing, it retires deep into the scrub or enters dark caverns and deposits its ova in wet sand or mud. Male and larva unknown.

Genotype.—*Idiophya nilgiriensis* (Fras.).

Idiophya nilgiriensis (Fraser).

Phyllomacromia nilgiriensis Fras. *Journ. Bom. Nat. Hist. Soc.*, Vol. xxv, pp. 383, 384 (1918); Id. ibid., Vol. xxvii, pp. 687, 688 (1921).

Idionyx nilgiriensis Fras. *Rec. Ind. Mus.*, Vol. xxvi, pp. 427, 460, 461 (*saffronata* nec *nilgiriensis*) (1924); Id. ibid., Vol. xxviii, pp. 196, 197, 198 (1926); Id. ibid., Vol. xxxiii, p. 447 (1931).

Female.—Abdomen 30-32 mm. Hindwing 32 mm. (Male unknown).

Head.—Labium dark brown; labrum bright citron or pale yellow bordered narrowly with blackish brown; clypeus glossy black; frons and vesicle dark metallic green; occiput black; eyes emerald green during life, paler above than below.

Prothorax brown; thorax metallic green with a narrow oblique pale yellow stripe on each side on middle of mesepimeron and a similar coloured stripe on the lower border of metepimeron; beneath pale yellow with a transverse stripe across the paired sclerites and a small obscure spot on the unpaired one. Legs yellow, femora black at distal ends, the anterior pair of tibiae also black; coxae yellow, this colour on the middle pair continued up a short distance on to thorax.

Wings hyaline palely tinted with golden yellow at the extreme base, in some specimens this area extends out nearly to the discoidal cells and in others, more adult, the whole of the wings are enfumed pale brown, this brown forming an areola around each cell of the wings, the cell middles being clear; membrane white; pterostigma black, very small, covering only 1 to 1½ cells; anal loop made up of 8 or 10 cells; discoidal cell in forewing four-sided; the costal and distal sides well separated; only a single row of cells between the beginnings of *IA* and *Cuii;* nodal index.—$\frac{6\text{–}12}{7\text{–}8}\Big|\frac{12\text{–}7}{8\text{–}6}, \frac{6\text{–}12}{8\text{–}8}\Big|\frac{13\text{–}6}{8\text{–}8}$.

Abdomen black; segment 2 with a crown-shaped citron yellow spot on middorsum, the base of the crown turned to the jugal suture and some obscure yellow markings extending outwards and apicalwards to join an incomplete yellow apical ring; segments 1 to 3 broadly yellow along the ventral borders. Vulvar scales small, triangular, not visible in profile. Anal appendages very small, shortly conical.

Distribution.—Known only from the Burliyar river, Nilgiri Hills. I have taken seven specimens in all of this interesting species, all being females and all taken within a small area during the months of June and July.

The type, now in the British Museum, was taken in 1917 and five more specimens were taken at the same spot in 1920 and 1921. I searched in vain for it during June 1931. The disastrous floods of 1923 tore the bottom out of the Burliyar river and swept most of the fauna away; several species once common there, such as *I. burliyarensis*, have totally disappeared. However, last year, 1932, I was fortunate enough to secure a seventh female quite near the old haunts so that the species still exists and the male may yet come to light. This was the only specimen seen although I repeatedly visited the river.

As mentioned above, the habits of *Idiophya nilgiriensis* are rather different from species of *Idionyx* as it keeps to close undergrowth along the banks of the river, threading its way with a very erratic and rather swift flight among the scrub or giant colladiums which grow in patches in marshy spots along the borders of the Burliyar. In flight it is remarkably invisible and a most bewildering insect to follow. The specimen I took in 1932 was seen and lost sight of four times before I took it with what was a blind cut at it with the net. It deposits its eggs in wet sand or mud, either in dark caverns among the rocks or under shelter of the colladiums which rise from a bed of black slimy mud.

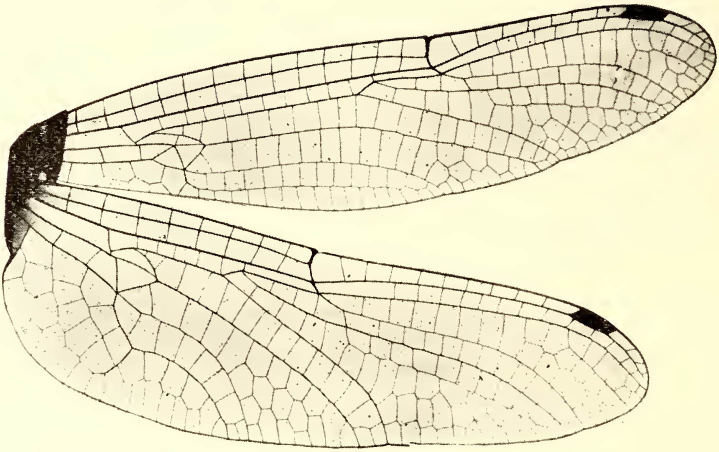


Fig. 2.—Wings of *Idionyx saffronata* Fras. ♂.

Genus: IDIONYX Hagen-Selys.

Idionyx Hagen, Zool. Bot. Ges. Wien. xvii, p. 58 (1867); Brauer, ibid., xviii, pp. 370, 742 (1868); Selys, C. R. Soc. Ent. Belg. xiv, p. 6 (1870); Id. Bull. Acad. Belg. (2) xxxi, p. 519 (1871); Id. ibid. xlv, p. 212 (1878); Kirby, Cat. Odon. p. 56 (1890); Karsch, Ent. Nach. xvii, p. 27 (1891); Martin, Cat. Coll. Selys, Cordulines, pp. 57, 80 (1906); Ris, Suppl. Ent. No. 1, p. 79 (1912); Fras. Journ. Bomb. Nat. Hist. Soc. Vol. xxvii, p. 688 (1921); Id. Rec. Ind. Mus. Vol. xxvi, p. 458 (1924); Id. ibid. Vol. xxviii, pp. 195-200 (1926); Id. ibid. Vol. xxxiii, p. 453 (1931).

Dragonflies of medium size belonging to the subfamily *Corduliinae.* Head very large, as large as the thorax; eyes globular, broadly contiguous; occiput very small; frons and vesicle metallic, the latter often of bizarre shape in the female. Prothorax small, posterior lobe simple; thorax small, metallic marked with yellow; legs long and slim, the hind femora extending to a little beyond the posterior end of thorax and armed with numerous closely-set, minute imbricated spines and two rows of fine hair-like spines on all three pairs. Tibial spines numerous, fine, long and closely-set; all tibiae with a membranous keel on the flexor surface, a long keel on the posterior pair but only a short distal one on the middle and anterior pairs of tibiae; tibial claws bifid. Keels absent in the females, otherwise the armature similar.

Wings hyaline, often saffronated at the bases in the females, rarely so in the males; occasionally deeply enfumed in the females, reticulation moderately close; bases shallowly notched in the male, broadly rounded in the female; hindwing much broader than the fore, especially in the female; 1 or 2 cubital nervures in forewings, only 1 in the hind; anal-loop shorter than in the *Libellulinae* and without the toe-like prolongation, of 4 to 7 cells in the male, 8 to 10 in the female; nodal index moderately high; hypertrigones traversed once or twice in the forewings, only once or entire in the hind; discoidal triangles and subtrigones entire; discoidal triangles in forewings equilateral, smaller than the adjacent subtrigone, its base situated far distad the level of the arc; in the hindwings, the distal and costal sides longer than the basal, the base slightly distad the level of the arc; sectors of arc in both fore and hindwings fused for a long distance; discoidal field in forewing made up of a single row of cells to beyond the level of the node and sometimes almost to border of wings; a single or a double row of cells for about 5 cells in the hindwing; 2 rows of postanal cells in forewings. Pterostigma short, covering 1½ to 3 cells, unbraced.

Abdomen cylindrical in the male, markedly compressed in the female, tumid at base and again somewhat expanded at the anal end; segment 10 in the male with a more or less marked carina or ridge which in some species is produced into a robust spine. Anal appendages of male markedly variable and complex, the superiors occasionally spined beneath, the inferiors usually more or less trifid or with lateral spines. Genitalia of male very homogeneous; lamina depressed, anterior hamules fine stilet-shaped organs, the posterior tumid and bearing a robust strongly curved spine; vulvar scale abbreviated, scoop-shaped, shortly triangular and projecting rather markedly in profile.

Distribution.—The Western Ghats of India, Himalayas, Assam, Burma, Java, Sumatra, Borneo, S. China, Malaysia and the Philippines.

Since I described the four species in Part X of this monograph, a mass of material has been collected and about 150 specimens including 16 species, have been available for this paper. Much also has been learnt of the habits of several species, more especially of those found in the Western Ghats which I have been able to study first-hand. Some species are gregarious and I have seen as many as thirty in one group engaged in a dancing flight like that of a swarm of midges. Both sexes mingle without any attempts at pairing, an action which I have only observed on two occasions in spite of great numbers observed. A male was seen to pounce from nowhere on to a solitary female and the two then flew swiftly down a deep culvert towards the bed of the major stream. *I. burlyarensis* has been seen frequently flying swiftly over the small pools in beds of streams apparently searching for females. Most species are found flying at about ten to thirty feet in the air in forest ridings and glades, others toward dusk descend and fly low over dirty cattle-standings on ghat roads where they probably find an abundance of food. All species breed in torrential mountain streams and none has been observed below an altitude of 2,000 ft.; the larva is distinctly Libelluline in character. The eggs are not laid direct into the parent stream but into seepages along their borders, ova being often laid direct on damp sand. Genotype.—*I. optata* Selys.

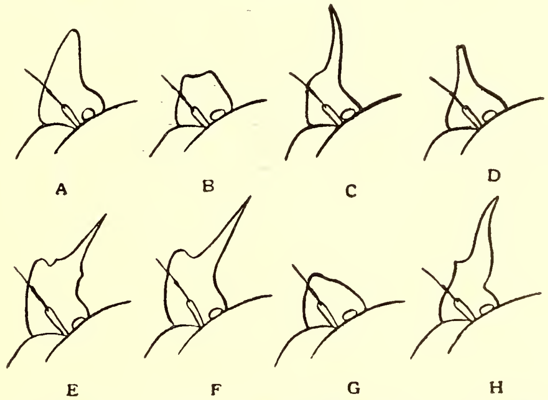


Fig. 3.—Vesicle seen in profile of the females of.—A. *I. burliyarensis* Fras B. *I. optata* Selys. C. *I. unguiculata* Fras. D. *I. intricata* Fras. E. *I. galcata* Fras. F. *I. rhinoceroides* sp. nov. G. *I. travancorensis* Fras. H. *I. corona* Fras.

Key to the males of genus *Idionyx*.

1. { Humeral yellow stripe present on thorax ... ... 2.
{ Humeral yellow stripe absent on thorax ... ... 5.

2. { Segment 10 without a dorsal spine ... *selysi* Fras.
{ Segment 10 with a long erect dorsal spine ... ... 3.

3. Superior anal appendages with a medio-ventral snipe ... ... 4.
Superior anal appendages without such a spine ... ... *intricata* Fras.

4. Inferior anal appendage with a very small lateral spine surmounting the posterior angle of a quadrate projection ... *optata* Selys.
Inferior anal appendage with a very robust simple lateral spine ... ... *stevensi* Fras.

5. Labrum bright citron yellow narrowly bordered with black ... ... 6.
Labrum entirely black ... ... *minima* Fras.

6. Superior anal appendages with a row of teeth beneath basal half ... ... 7.
Superior anal appendages naked beneath ... ... 8.

7. Inferior anal appendage trifid, the apical portion very narrowly and deeply emarginate, sloping strongly up at an angle to the basal portion ... ... *galeata* Fras.
Inferior anal appendage trifid, the apical portion broad and shallowly emarginate, directed straight back in line with the basal portion ... ... *saffronata* Fras.
Inferior anal appendage trifid, the apical portion very narrowly and deeply emarginate, directed straight back in line with the basal portion ... ... *travancorensis* Fras.

8. Superior anal appendages simple at apices; inferior variable ... ... 9.
Superior anal appendages curled spiral-wise at apex and ending in a tuft of hairs ... ... *unguiculata* Fras.

9. Lateral lobes of inferior anal appendage mere tiny thin erect spines; superior anal appendages shorter than inferior ... *burliyarensis* Fras.
Lateral lobes of inferior anal appendage represented by a mere angulation upwards of the lateral border; superior anal appendage shorter than inferior *corona* Fras.
Lateral lobes of inferior anal appendage long robust spines; superior anal appendages longer than inferior *imbricata* Fras.

(The males of *I. rhinoceroides* and *nadganiensis* are unknown.)

Key to the females of genus *Idionyx*.

1. Vesicle produced and occasionally complex ... ... 2.
Vesicle simple, rounded or slightly notched at apex ... ... 6.

2. Humeral thoracic stripe present; vesicle surmounted by four tubercles ... *optata* Selys.
Humeral thoracic stripe absent ... ... 3.

3. Vesicle produced as a simple spine or horn ... ... 4.
Vesicle produced as a complex horn ... ... 5.

4.	Vesicle a short blunt horn	*travancorensis* Fras.
	Vesicle a short tapering horn with bifid apex	*intricata* Fras.
	Vesicle a short cone surmounted by a long fine acutely pointed spine	*unguiculata* Fras.
	Vesicle an elongate bluntly pointed curved cone	*burliyarensis* Fras.
5.	Vesicle a short cone with a sinuous spine extending back from its apex	*coronata* Fras.
	Vesicle a short cone with a long simple straight spine extending back from its apex	*rhinoceroides* sp. nov.
	Vesicle a short cone surmounted by an obtuse tubercle with a tent-shaped spine extending back from its apex	*selysi* Fras.
6.	Humeral thoracic stripe present	7.
	Humeral thoracic stripe absent	9.
7.	Bases of wings broadly tinted with golden amber to the level of distal end of discoidal cells; vesicle conical	*stevensi* Fras.
	Bases of wings uncoloured or but slightly so at extreme bases; vesicle blunt, slightly notched	8.
8.	All tibiae bright citron yellow; pterostigma short, covering less than 2 cells; abdomen shorter than wings	*selysi* Fras.
	Only the hind tibiae yellow; pterostigma long, covering 2 to 3 cells; abdomen longer than the wings	*nadganiensis* Fras.
9.	Labrum entirely black	*minima* Fras.
	Labrum bright citron yellow narrowly bordered with black	10.
10.	Bases of wings broadly tinted with golden amber to or beyond the level of distal end of discoidal cells	*saffronata* Fras.
	Bases of wings not tinted or only at extreme bases	*imbricata* Fras.

Group I.—*optata*.

Humeral yellow stripe present in both sexes; superior anal appendages of male shorter than the inferior and possessing a ventral spine; female with abdomen markedly compressed and not dilated at the end; vesicle simple or specialized; wings variably tinted with golden yellow at the base.—*optata, yolanda, carinata, intricata, stevensi* and *nadganiensis.*

Group II.—*corona.*

Humeral stripe absent in both sexes; superior anal appendages as long as or longer than the inferior and without a ventral spine; no dorsal spine to segment 10; female with abdomen markedly compressed and not dilated at the end; vesicle specialized; wings not tinted at base or only at the extreme base. —*corona, burliyarensis, unguiculata* and *rhinoceroides.*

Group III.—*dohrni.*

Characters similar to the last group save that the female vesicle is simple and the female of *imbricata* has a vestigial humeral stripe present.—*montana, imbricata, philippa* and *dohrni.*

Group IV.—*saffronata.*

Humeral stripe absent in both sexes; superior anal appendages longer than the inferior and with a row of minute teeth on the ventral surface; female with vesicle simple except in *galeata* and with the wings usually broadly tinted at the base.—*galeata*, *saffronata*, *minima* and *travancorensis*.

Group V.—*claudia*.

Humeral stripe absent in both sexes; superior anal appendages of male of the same length as the inferior, short, simple and Libelluline in character; female with abdomen markedly compressed, not dilated at the end; wings broadly tinted at base; vesicle simple; male with robust spine on dorsum of segment 10.—*claudia*.

Group VI.—*selysi*.

Humeral stripe present in both sexes; female with abdomen markedly compressed and not dilated at the end; wings not tinted at base; vesicle simple; male with a long tapering spine on dorsum of segment 10; superior anal appendages slightly longer than inferior and without a ventral spine.—*selysi*.

Idionyx saffronata Fraser.

Idionyx saffronata Fras. Rec. Ind. Mus. Vol. xxvi, pp. 427, 458-460 (1924); Id. ibid. Vol. xxviii, pp. 196, 197 and 198 (1926); Id. ibid. Vol. xxxiii, pp. 447, 456 (1931).

Male.—Abdomen 33 mm. Hindwing 34 mm.

Head.—Labium brownish yellow bordered diffusely with brown; labrum bright chrome yellow bordered with black; ante- and post-clypeus glossy black; frons dark metallic blue or violet; vesicle dark metallic violet, tumid, nearly as broad as frons, rounded above; occiput black; eyes emerald green.

Prothorax blackish brown. Thorax brilliant metallic green with a narrow medial oblique stripe on each side and the posterior half of the metepimeron yellow. Beneath striped alternately black and yellow, two stripes of each colour.

Legs black, the middle and anterior pairs of femora yellow on the inner sides; tibiae yellow striped with black on the flexor surface.

Wings hyaline, very palely enfumed or saffronated as far out as a little beyond the tornus, more deeply so in the subcostal and cubital spaces and anal triangle; pterostigma black, small, covering $1\frac{1}{2}$ cells; membrane cinereous; anal-loop made up of 7 to 8 cells; nodal index—$\frac{7\text{–}13}{9\text{–}8}\Big|\frac{13\text{–}8}{8\text{–}9}$.

Abdomen black, the first and second segments marked narrowly along the ventral borders with citron yellow; segments 7 to 10 bordered with bright yellow beneath; segment 10 strongly keeled but without a dorsal spine.

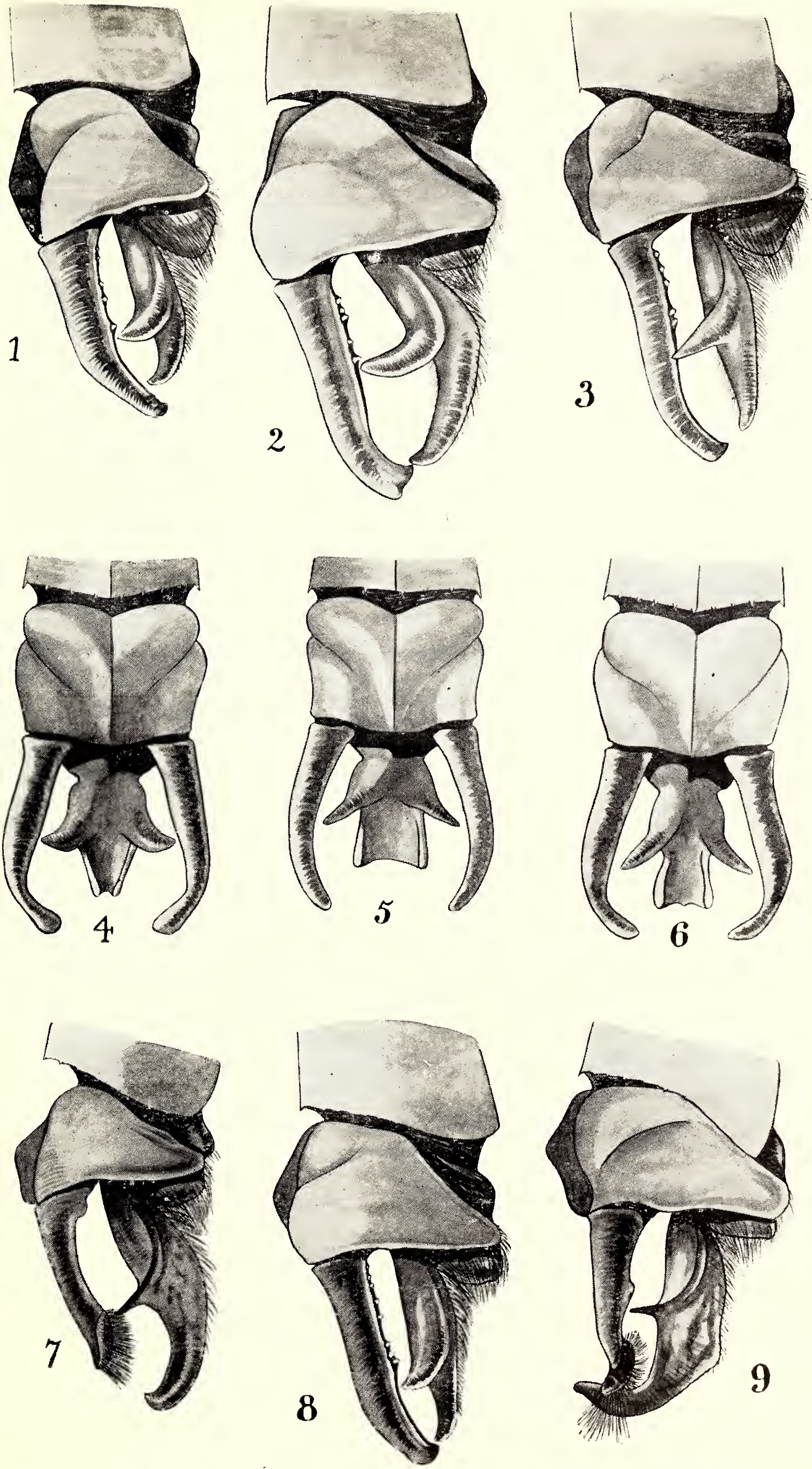
Anal appendages black; superiors tapering from base to apex, flattened on the inner side, apical third angled obtusely inward; an irregular row of minute teeth on the ventral surface near the base of the appendage; inferior directed straight back, the apex not curled up, but deeply trifurcate, the lateral lobes robust, slightly upturned widely divaricate spines, the middle lobe excavate, broad at apex and with a slight prominence at its middle. Genitalia:—lamina broadly and deeply excavate, an emarginate plate projecting from its free border; hamules very tumid, chelate, the outer claw tumid, short, the inner of the same length, prolonged as a long curled spine; lobe rounded, broad, yellow and coated with long yellow hairs.

Female.—Abdomen 34 mm. Hindwing 35 mm.

Closely similar to the male, but differing as follows:—wings hyaline or more or less deeply enfumed especially towards the apices, the bases tinted with deep golden yellow as far out as the level of the outer end of trigones and for the whole breadth of forewings and nearly to the apex of anal-loop in the hind; pterostigma black, small, unbraced, covering 2 cells; nodal index.—

$\frac{7\text{–}13}{9\text{–}8}\Big|\frac{12\text{–}7}{8\text{–}9}$, $\frac{7\text{–}15}{9\text{–}9}\Big|\frac{14\text{–}6}{9\text{–}9}$.

Abdomen glossy black, the central lateral borders of segments 1 to 3 and special borders of 1 and 2 moderately broadly citron yellow. Vulvar scale very prominent as viewed from the side, acute and strongly keeled.



Anal appendages of Dragonflies. (For explanation of plate see end of article.)

Distribution.—Coorg at altitudes of about 3,000 ft. and upwards, Annaimallai Hills, S. Malabar and Travancore; common in the first of these localities but far less so in the others. In Coorg, during May and June it was common to see swarms of these insects engaged in what appeared to be a nuptial flight; 30 or more would be seen dancing up and down in the air in a forest clearing or over the forest roads. They fly only during sunlight; even a cloud passing over being sufficient to send them off into the jungle for shelter.

The broadly saffronated wings of the female together with the simple shape of the rounded vesicle will serve to distinguish it from other females except *minima*, which latter however is much smaller and has the labrum entirely black. The male is distinguished by the specific shape of its inferior anal appendage, the middle lobe of which is very broad and directed straight back.

Type male and allotype female have been deposited in the British Museum. May and June are the months to seek this insect.

Idionyx travancorensis Fraser.

Idionyx travancorensis Fras. Rec. Ind. Mus. Vol. xxxiii, pp. 447, 455, 456 (1931).

Male.—Abdomen 32 mm. Hindwing 32 mm.

Head.—Labium blackish brown, paler laterally; labrum citron yellow broadly bordered with black; clypeus and genae black; frons anteriorly and above metallic bluish green; vesicle metallic bluish violet; occiput black; eyes emerald green.

Prothorax blackish brown; thorax metallic green, humeral stripe absent; laterally a narrow oblique stripe at the level of the spiracle and another on the hinder border of metepimeron; beneath black bordered with yellow and with a stripe of paler yellow at its middle. Legs black, tibiae yellow on extensor surface.

Wings hyaline very palely and uniformly tinted with yellow. Pterostigma black, covering $1\frac{1}{2}$ cells, short; membrane cinereous; anal-loop made up of 7 to 8 cells; nodal index.—$\frac{7\text{–}12}{8\text{–}8}\Big|\frac{12\text{–}7}{8\text{–}9}$.

Abdomen black, unmarked save for the ventral border of segment 2 and a narrow apical stripe on the same segment yellow; segment 10 strongly carinated but without a dorsal spine.

Anal appendages black; superiors shaped very similarly to those of *I. saffronata* but with the apex angulated more abruptly down. The minute ventral spines present as two groups of 2 or 3 respectively. Inferior appendage differing more widely, its apex tapering to an obtuse emarginate point less than half the breadth of that of *I. saffronata;* the lateral robust spines are much stouter and turned more abruptly outward. Viewed in profile, this appendage however is strikingly like that of *I. saffronata.*

Female.—Abdomen 32-35 mm. Hindwing 34-35 mm.

Resembles the male closely but differs by the colour of the wings and sexual morphology. Vesicle cone-shaped, the cone blunt and differing rather strongly from that of *I. burliyarensis.* The abdomen depressed and fusiform in shape towards the anal segments and somewhat similar to that of the female of *I. nilgiriensis.*

Wings burnt brown throughout, the cell-middles paler giving a stippled appearance to the wing; the bases deeply saffronated or golden yellow as far out as the level of trigones; other details of the wings similar to the male. Vulvar scale similar to that found in *I. saffronata.*

Distribution.—Travancore and the Annaimallai Hills at altitudes of 3,000-4,000 ft. during May and June. The male is easily distinguished by the shape of its inferior anal appendage and the female by its saffronated wings and conical vesicle. Habits similar to those of *I. saffronata* with which I found it in company on the ghat road leading from Munnar, Travancore to Cochin State. Type and allotype female at present in my own collection. Closely related to *I. saffronata*, *minima* and *galeata.*

Idionyx minima Fraser.

Idionyx minima Fras. Rec. Ind. Mus. Vol. xxxiii, pp. 447, 453-455 (1931).

Male.—Abdomen 27 mm. Hindwing 30 mm.

Head.—Labium, labrum, clypeus and genae black, unmarked; frons anteriorly and above metallic prussian blue; vesicle metallic blue; occiput black; eyes emerald green.

Prothorax blackish brown; thorax metallic green changing on the lower parts of sides to metallic blue; humeral stripe absent but a narrow oblique citron yellow stripe on each side at level of the spiracle and a similar stripe on the posterior border of metepimeron. Beneath brownish black encircled with yellow. Legs black, tibiae striped with yellow on extensor surface.

Wings hyaline, the bases very palely saffronated as far out as 2 cells distad the trigones; pterostigma black, very short, twice as long as broad, only covering 1 to 1½ cells; anal-loop made up of 7 cells; membrane cinereous; nodal index.—$\frac{7\text{–}12}{7\text{–}8}\Big|\frac{13\text{–}6}{9\text{–}6}$.

Abdomen black, unmarked; segment 10 strongly keeled but without a dorsal spine. Anal appendages black; superiors rather longer than segment 10, broad at base, tapering as far as apex, the distal half curved inwards at an obtuse angle and also downward, the apex ending in a short point; a row of minute teeth on the ventral surface of the basal two-thirds as in *I. saffronata*.

Inferior appendage shorter than superiors, deeply trifid and shaped like a bird's claw, the middle lobe very broad and only shallowly emarginate as viewed from above and its apex curled rather strongly up, the lateral spines rather narrow and widely divaricate.

Female.—Abdomen 29-31 mm. Hindwing 30 mm.

Marked similarly to the male. Differs only in sexual characters and in the colouring of the wings which are a deep golden amber as far out as 2 cells beyond the trigones. Vesicle simple, rounded and very slightly notched above.

Distribution.—From Travancore only. I took a few specimens of both sexes flying among tea off the Munnar ghat road during June. It is the smallest species of the genus and is closely related to the two foregoing species and to *I. galeata* by the shape of the anal appendages and especially that of the superiors with the characteristic row of minute teeth beneath near the base. The glossy jet black labrum will serve to distinguish it at once from all of these species, this character applying equally to both sexes.

Idionyx galeata Fraser.

Idionyx galeata Fras. Rec. Ind. Mus. Vol. xxvi, pp. 517, 519 (1924); Id. ibid. Vol. xxviii, pp. 196, 197, 198 (1926); Id. ibid. Vol. xxxiii, p. 447 (1931).

Male.—Abdomen 35 mm. Hindwing 35 mm.

Head.—Labium, labrum and face dark blackish brown; frons in front and above brilliant metallic green; vesicle metallic bluish green or violaceous; occiput black; eyes emerald green.

Prothorax blackish brown; thorax metallic green with a golden reflex laterally; humeral stripe absent; laterally an oblique citron yellow stripe bordering the antero-lateral suture posteriorly and a similar stripe on the lower posterior border of metepimeron. Beneath blackish striped with yellow obscurely, the paired sclerites black.

Legs black, anterior and middle coxae yellow; tibiae yellow on extensor surface; the keel on hind tibiae with an interruption in its continuity near the distal end.

Wings hyaline, palely and uniformly tinted with yellow; the neuration sometimes surrounded with an areola of brownish, the cell-middles being clear; pterostigma black, covering only 1½ cells; membrane dark cinereous; anal loop made up of 8 cells; nodal index.—$\frac{8\text{–}14}{9\text{–}9}\Big|\frac{14\text{–}8}{9\text{–}9}$, $\frac{8\text{–}13}{10\text{–}9}\Big|\frac{14\text{–}7}{9\text{–}9}$.

Abdomen black, the borders of segment 2 ventrally yellow as also a fine incomplete annule on the apical border. Anal appendages black; superiors rather longer than the inferior, subcylindrical and tapering to apex which is a little dilated and turned inwards and a little downwards as viewed from the side; a row of fine teeth along the ventral border especially near the base. Inferior broadly and deeply trifid, shaped like an eagle's talon, the apex narrowly emarginate and turned up very steeply; the lateral lobes large robust spines slanted almost straight upward.

Female.—Abdomen 37 mm. Hindwing 37 mm.

Closely resembles the male save for its sexual characters; differs as follows:—vesicle remarkably specialized, its apex obtuse and with a protuberance behind it shaped like a minaret ending in a fine spine; prothorax a paler brown; thorax without the yellow bordering to the metepimeron; ventral borders of segments 2 and 3 citron yellow; wings hyaline, the bases palely tinted with golden yellow as far out as the third antenodal nervure in the forewing and the second in the hind. Occasionally females are taken with the tinted area extending as far out as the outer end of discoidal triangles in the hindwing and the whole wing more or less deeply enfumed or stippled with warm brown. The female differs from the male and from most other species of the genus by having a double row of cells between the origins of *IA* and *Cuii* in the hindwing.

Distribution.—Coorg and S. Kanara. I took a number of both sexes at Katlikad Estate near Mercara but never found it elsewhere in Coorg. Mr. S. A. Souter found it swarming at about 4,500 ft. on the slopes of Kudremukh, S. Kanara about the middle of June. Most of the specimens were flying quite low over coffee bushes or along the borders of ferny banks. The male is easily distinguished by the shape of its anal appendages and the female by the unique shape of its vesicle.

Idionyx burliyarensis Fraser.

Idionyx corona race *nilgiriensis* Fras. Mem. Dept. Agric. India, Vol. vii, No. 7, pp. 65, 66 (1922).

Idionyx corona burliyarensis Fras. Rec. Ind. Mus. Vol. xxvi, pp. 427, 461, 462 (1924).

Idionyx burliyarensis Fras. Rec. Ind. Mus. Vol. xxviii, pp. 196-198 (1926); Id. ibid. Vol. xxxiii, p. 447 (1931).

Idionyx corona fulvia Fras. Rec. Ind. Mus. Vol. xxvi, pp. 516, 517 (1924).

Male.—Abdomen 35 mm. Hindwing 33 mm.

Head.—Labium bright citron yellow; labrum citron yellow heavily bordered with dark brown; clypeus dark metallic blue; frons broadly rounded, dark metallic green; vesicle dark metallic blue; occiput black; eyes emerald green during life.

Prothorax brown; thorax metallic emerald green with a golden reflex; humeral stripe absent; laterally a moderately broad citron yellow stripe obliquely traversing the spiracle and a similar stripe on the posterior and lower border of metepimeron; beneath yellow, the paired and unpaired sclerites black with a bluish reflex.

Legs black; tibiae paler on extensor surface; the anterior pair with a keel on the outer third, the hinder with a complete keel.

Wings hyaline, untinted save in very adult specimens which may be slightly enfumed; pterostigma black, covering $2\frac{1}{2}$ cells; anal-loop made up of 8 cells; hypertrigones traversed, those of the forewing often twice; usually 2 cubital nervures in forewings, 1 in the hind; membrane palely cinereous; nodal index.—

$$\frac{6\text{–}13}{9\text{–}9}\,\Big|\,\frac{14\text{–}8}{9\text{–}10}.$$

Abdomen black, the ventral borders of segments 1 to 3 yellow as also the intersegmental joint between segments 2 and 3. Anal appendages black; superiors much shorter than the inferior, subcylindrical, rather flattened towards the apex which is bevelled beneath and furnished with a tuft of long coarse golden hairs; inferior very massive, its apex curled strongly up and narrowly emarginate, its lateral spines very small, finely pointed and directed straight up; the appendage deeply hollowed out above in its apical half. Genitalia very similar to that of *I. saffronata*.

(This sex has not been described heretofore.)

Female.—Abdomen 35 mm. Hindwing 35 mm.

Closely similar to the male, differing only in sexual characters and a few minor points. The eyes are emerald green capped with brown; the labrum entirely yellow and there is also a small triangular spot of yellow on the anteclypeus. The wings have amber tinted streaks or rays in the subcostal and cubital spaces and they are more or less enfumed according to age. Anal-loop made up of 8 to 10 cells; nodal index.— $\frac{9\text{-}17 | 15\text{-}8}{10\text{-}10 | 10\text{-}10}$, $\frac{8\text{-}14 | 13\text{-}8}{10\text{-}8 | 9\text{-}10}$. The vesicle is specialized and shaped like the horn of a rhinoceros, its apex prolonged, curling back and bluntly acuminate. Abdomen with the ventral borders of segments 1 to 4 yellow, as also the intersegmental joints between 2nd and 3rd and 3rd and 4th segments. Vulvar scale shaped as in *I. saffronata,* prominent and projecting.

The race *fulvia* has the male similar to type but the females have the wings very deeply enfumed; in some this is a warm uniform reddish brown tint throughout but in others it is paler, but the basal marking is a rich maroon extending out fanwise as far as the outer end of discoidal triangles in both wings; the pterostigma is slightly longer and often covering 3 cells.

Distribution.—Coorg, S. Malabar, and rare in the Annaimallai Hills and Travancore. The race *fulvia* is confined to Coorg on the Sampaji Ghat road. *I. burliyarensis* used to be plentiful in the bed of the Burliyar river, Mettupalayam Ghat but has completely disappeared of late years since the dissatrous floods of 1923, which tore the bottom out of the river and swept away its fauna. It is quite common in Coorg and the race *fulvia* is plentiful near Sampaji. The males appear on the wing about four in the afternoon and are found flying over the river bed, whilst the females hug the ground around villages or at spots where carts rest for the night; over these dirty cattle-standings an abundance of small flies and midges afford them all the food they need. The dark coloured wings render them almost invisible when flying low over the ground and their dancing erratic aery flight make them most difficult to capture. May and early June are the months in which they should be sought. The male is easily determined by the curious shape of its anal appendages, and the female equally so by its curious shaped vesicle. Type and allotype female in the British Museum.

Idionyx corona Fraser.

Idionyx corona Fras. Journ. Bom. Nat. Hist. Soc., Vol. xxviii, pp. 690, 691 (1921); Id. Mem. Dept. Agric. India, Vol. vii, No. 7, pp. 64, 65, pl. vii, fig. 5 (1922); Id. Rec. Ind. Mus., Vol. xxvi, pp. 427, 462 (1924); Id. ibid. Vol. xxviii, p. 197 (1926).

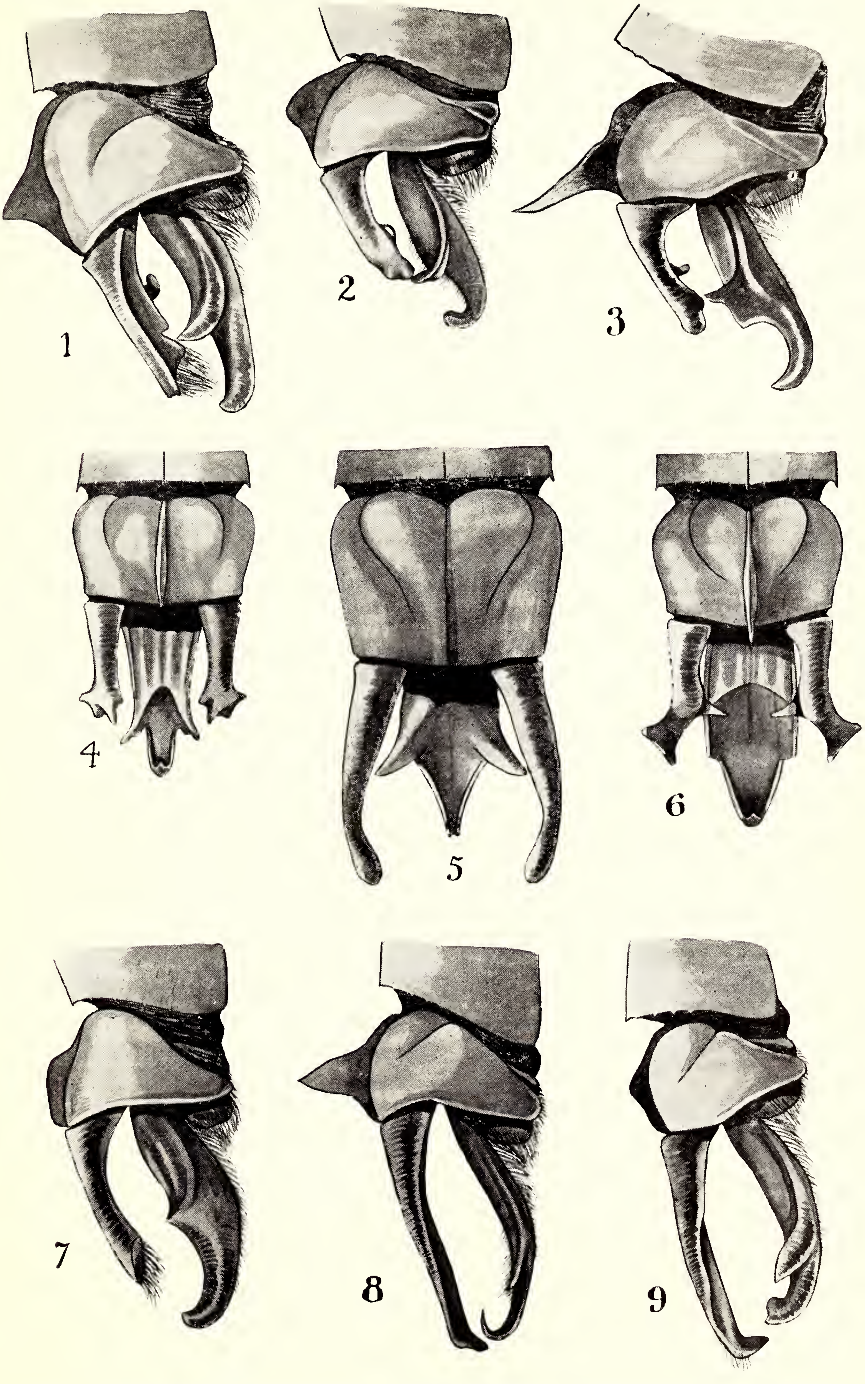
Male.—Abdomen 29 mm. Hindwing 30 mm.

Head.—Labium bright yellow; labrum citron yellow changing to pale brown at the border; anteclypeus with a triangular spot of citron yellow at its centre; postclypeus black; frons and vesicle metallic dark bluish green, the latter conical; occiput black; eyes emerald green.

Prothorax yellowish; thorax metallic green with a golden reflex, with only a vestigial humeral yellow stripe which is entirely concealed by the head; laterally a narrow oblique yellow stripe traversing the spiracle and another along the lower border of metepimeron; beneath yellow, the sclerites dark brownish black. Legs black, tibiae yellow on extensor surface; a short distal keel on anterior tibiae and a complete one on the posterior pair.

Wings hyaline tinted with pale golden yellow at base and diffusely so along the costal border nearly as far as pterostigma; the latter organ black, rather longer than usual, covering 3 cells; membrane pale brown; anal-loop with 8 to 9 cells; 2 cubital nervures in forewings, one in the hind; hypertrigones traversed twice in forewings, only once in the hind; nodal index, $\frac{8\text{-}13 | 14\text{-}8}{10\text{-}10 | 10\text{-}11}$.

Abdomen black, segments 2 and 3 narrowly yellow along the ventral border; segment 10 prominently keeled. Genitalia closely similar to that of *I. saffronata.* Anal appendages black; superiors much shorter than inferior, subcylindrical, the end bevelled beneath and bearing a few long hairs; seen laterally



Anal appendages of Dragonflies. (For explanation of plate see end of article.)

this appendage is curved gently downwards; inferior very similar to that of *I. burliyarensis* but the lateral spines are entirely missing or merely represented by a lateral angulation of the appendage.

Female. Abdomen 32 mm. Hindwing 38 mm.

Closely similar to the male in colour and markings, the labrum bordered with dark brown and the anteclypeus without the central triangular yellow spot; vesicle markedly specialized, prolonged into an elevated spine shaped like the spout of a tea-pot, this spine springing from the posterior aspect of the apex of the vesicle; wings hyaline but with a dark brown areola surrounding all the neuration, the cell-middles being clear; the base of all wings tinted with golden yellow, this colour extending also along the costa as far as the pterostigma; pterostigma black, covering 2½ cells; membrane white changing to brown posteriorly; anal-loop made up of 11 cells; hypertrigones traversed once in forewings, entire in the hind; nodal index.— $\frac{8\text{-}13}{9\text{-}9}\Big|\frac{12\text{-}7}{9\text{-}9}$.

Abdomen and legs similar to the male; vulvar scale prominent, triangular and projecting.

Distribution.—Only a single pair of this insect is known, the type being a female from the Bababuddin Hills, Mysore, taken June 1915. The male allotype is in my own collection and was taken by Mr. C. A. Souter, I. C. S., at Shiradi, Saklespur Ghat, S. Kanara, 8-5-22. The species is a small one and varies from others by the male, as well as by the female, having the wings tinted with golden yellow along the costa nearly to the pterostigma. The inferior appendage without lateral spines will serve to distinguish it from others of the same group, whilst the female is easily distinguished by the shape of its unique vesicle. Type in the British Museum.

Idionyx rhinoceroides sp. nov.

Female.—Abdomen 32 mm. Hindwing 35 mm. (Male unknown).

Head.—Labium dark brown; labrum yellow diffusely and narrowly bordered with brown; clypeus black; frons and vesicle dark metallic violet or violaceous blue, the latter highly specialized, the base prolonged and blunt at apex from the back of which projects a very long straight tapering spine; occiput black; eyes emerald green.

Prothorax yellowish; thorax emerald metallic green, densely coated with long yellow hairs on dorsum; laterally a narrow oblique citron yellow stripe traversing the spiracle and another bordering the lower part of metepimeron; beneath yellow with oblique bluish black stripes on the paired sclerites and a triangular blackish brown spot on the unpaired. Humeral stripe absent.

Legs black; coxae yellow as also the extensor surfaces of all tibiae.

Wings hyaline but enfumed with warm reddish brown which forms a thick network corresponding to the neuration of the wings, the cell middles being clear; this brown colour deepest at the apices of hindwings; extreme bases tinted with golden yellow; pterostigma short, black, covering 1½ cells only; hypertrigones traversed once in the forewings, entire in the hind; anal-loop made up of 12 to 13 cells; nodal index,— $\frac{7\text{–}11}{8\text{–}9}\Big|\frac{12\text{–}7}{9\text{–}8}$.

Abdomen black, the ventral borders of segments 2 and 3 citron yellow; vulvar scale triangular, projecting as in the last species.

Distribution.—South Malabar; a single female in my own collection collected at Dhoni near Mannarghat in May. Distinguished from all other species by the unique shape of its vesicle. It is evidently closely allied to the last species and probably belongs to the same group.

Idionyx unguiculata Fraser.

Idionyx unguiculata Fras. Rec. Ind. Mus. Vol. xxviii, pp. 20-4205 (1926).

Male.—Abdomen 32 mm. Hindwing 31 mm.

Head.—Labium pale brownish yellow; labrum citron yellow narrowly bordered with black; anteclypeus black with a yellow centre; postclypeus black with a bronzed reflex; frons and vesicle metallic bluish green; occiput black; eyes emerald green during life.

Prothorax brown, the posterior lobe yellowish; thorax metallic green; humeral stripe absent; laterally a narrow oblique citron yellow stripe traversing the spiracle and the lower border of metepimeron the same colour; beneath yellow, paired sclerites brownish black with bluish reflex. Legs black; tibiae paler on extensor surface, their keels similar to those of *I. corona.*

Wings hyaline, only the extreme bases palely tinted with golden yellow; pterostigma black, covering from 1½ to 2 cells; anal-loop made up of 9 to 10 cells; membrane greyish white; nodal index.—$\frac{7\text{–}13}{9\text{–}8}\Big|\frac{14\text{–}7}{8\text{–}8}$.

Abdomen black, the ventral borders of segments 1 to 3 and a fine mid-dorsal stripe extending from segment 1 to the middle of 3 citron yellow; the intersegmental nodes palely yellow from segments 3 to 7, the latter segment with a ventral tuft of yellow hairs as seen in most species; segment 10 strongly keeled, this keel almost amounting to a dorsal spine. Anal appendages black; superiors as long as segments 9 and 10, subcylindrical, tapering slightly towards the apex which has a spiral twist from within downwards and out, the apex of the spiral bearing a tuft of coarse yellow hairs. Inferior appendage considerably longer and of much heavier build, the basal half broad and deep and directed almost straight back on a horizontal plane, the apical portion curled rapidly and strongly up and tapering to a fine point; deeply grooved and hollowed out above and with a small upright spine at its middle on each side perched on the thin lateral borders. Genitalia similar to that of *I. saffronata.*

Female.—Abdomen 31 mm. Hindwing 28 mm.

Very similar to the male, differing in sexual characters and the following points:—vesicle markedly specialized, produced into a long horn somewhat like that seen in *I. corona* but its point recurved forwards instead of backwards and not hollowed out in front; a short vestigial humeral stripe completely obscured by the head; wings with dark golden yellow rays in the subcostal and cubital spaces, the intervening parts more palely tinted as far distal as the 2nd antenodal nervure; in tenerals this tinting is deeper and more extensive outwards. Adults also have the whole of the wing membrane palely enfumed; there are 2 rows of cells between *IA* and *Cuii* in the hindwing at their commencement instead of only 1 row found in the male; anal-loop with 9 to 11 cells; nodal index.— $\frac{8\text{–}12}{9\text{–}8}\Big|\frac{14\text{–}7}{8\text{–}8}$, $\frac{7\text{–}13}{8\text{–}8}\Big|\frac{12\text{-}8}{7\text{–}10}$, $\frac{5\text{–}13}{8\text{–}8}\Big|\frac{12\text{–}6}{7\text{–}9}$. Vulvar scales not differing from the last species.

Distribution.—Maymyo, Upper Burma. A single male and three females collected by Col. F. W. Wall, I.M.S., are now in my collection. The male is easily distinguished by the spiral twist of the apex of the superior appendages and by the tuft of yellow hairs on the same; the female may be distinguished by the shape of its vesicle and also by its vestigial humeral stripe.

Idionyx imbricaita Fraser.

Idionyx imbricata Fras. Rec. Ind. Mus. Vol. xxviii, pp. 197, 198, 205, 206 (1926).

Male.—Abdomen 28 mm. Hindwing 30 mm.

Head.—Labium bright yellow; labrum bright citron yellow narrowly bordered with black; anteclypeus black with a small triangular spot of citron yellow at its middle confluent with the yellow on labrum; postclypeus black; frons and sides of latter metallic bluish green; vesicle blue metallic; occiput black; eyes emerald green.

Prothorax blackish brown, posterior lobe bright yellow. Thorax metallic green or bluish green with a golden reflex; humeral stripe absent; laterally a narrow oblique median citron yellow stripe and the lower posterior half of metepimeron of the same colour; beneath yellow with the paired and unpaired sclerites bluish black. Legs black; the two posterior pairs of tibiae bright yellow, the anterior pair of the same colour on the outer side; tibial keels on anterior pair extending nearly half the length of limb, and for four-fifths the length of tibiae on the posterior pair.

Wings hyaline, bases palely tinted with golden yellow as far distad as the discoidal triangles; anal-loop made up of 9 to 10 cells; pterostigma black, covering only 2 cells; nodal index.— $\frac{6\text{–}12}{9\text{–}8}\Big|\frac{12\text{–}7}{9\text{–}9}$.

Abdomen black; segments 1 and 2 with a broad middorsal bright yellow stripe extending from base to apex; segment 3 with a similar but finer stripe, whilst all three are yellow along the ventral borders, as also are segments 7 to 9 along the lower border. Segment 10 with a blunt middorsal keel not amounting to a spine.

Anal appendages black; superiors longer than inferior, subcylindrical, directed straight back but the extreme apex abruptly turned downwards and slightly inwards; the appendage twisted on itself so that the external surface ultimately comes to look upwards and inwards; inferior appendage more massive, deeply trifid, the apical median portion curled strongly upwards, pointed at the end and tumid immediately before this point above; the outer lobes robust spines, directed slightly upwards, backwards and outwards.

Female.—Abdomen 31 mm. Hindwing 33 mm.

Very similar to the male save for sexual characters; the postclypeus yellowish; vesicle simple, rounded as in the male; a vestigial humeral stripe present but which is entirely concealed by the overhanging head; legs blackish brown.

Wings hyaline, brightly tinted with golden-yellow at the extreme base; anal-loop with 10 cells; 2 cubital nervures in the hindwing; all hypertrigones traversed once; pterostigma small, covering 2 to 2½ cells; only a single row of cells between the commencements of *IA* and *Cuii* in the hindwing as in the male; nodal index.— $\frac{8\text{-}13}{10\text{-}9}\Big|\frac{13\text{-}8}{9\text{-}10}$.

Abdomen black; segments 2 and 3 with the middorsal ridge narrowly yellow as also the joint between the two segments; ventral borders of segments 2, 3, 7 and 8 yellow. Vulvar scale not differing markedly from others of the genus but rather shorter and obtuse at apex.

Distribution.—Reported only from Shillong, Assam from June to August at an altitude of 6,000 ft. Type in the British Museum, allotype female in the Morton collection. (In the original description it was stated that the female was unknown although this sex was actually described; the mistake arose from the latter description being added later during correction of the proofs and without deleting the former note.) This species is closely related to *I. dohrni* by the shape of its appendages etc. The female may be determined from others by the vestigial humeral stripe combined with a simple vesicle, and from *I. dohrni,* from Borneo, by the wings less tinted with yellow; the male is easily distinguished from all other Indian species by its long attenuated appendages, much longer than the inferior, whilst it differs from *I. dohrni* by the shape of the inferior appendage, more robust, the apex not ending in a fine prolonged spine and the lateral spines much longer and more robust, these being almost vestigial in the latter species.

Idionyx optata Selys.

Idionyx optata Selys, 2nd Additions Syn. Cordulines, Bull. Acad. Belg. (2) xlv, p. 196 (1878); Id. Ann. Mus. Civ. Genov. xxx (x), p. 472 (1891); Mart. Cat. Coll. Selys. (Cordulines) p. 80 (1906); Ris. Suppl. Ent. No. 1, pp. 82, 83 (*carinata* nec *optata*) (1912); Fras. Rec. Ind. Mus. Vol. xxxiii, pp. 196, 198, 200, 201 (1926).

Idionyx ornata Fras. (the female of *optata*) Mem. Dept. Agric. India. Vol. vii, No. 7, pp. 66, 67 (1922); Id. Journ. Bom. Nat. Hist. Soc. Vol. xxvii, pp. 688, 689 (1921).

Male.—Abdomen 33-34 mm. Hindwing 33 mm.

Head.—Labium bright ochreous; labrum bright yellow bordered with dark brown; clypeus and front of frons as well as its sides and genae bright yellow; frons above metallic bluish green; vesicle metallic bluish green marked in front with ochreous; occiput black; eyes emerald green during life.

Prothorax dark ochreous; thorax metallic emerald green on dorsum, dark metallic blue on the sides, marked with short bright clear cut humeral stripes of citron yellow extending halfway up the dorsum and laterally, by similarly coloured oblique stripes on the mesepimeron and lower part of metepimeron; beneath yellow, the sclerites dark brown with a bluish reflex. Legs dark reddish brown, tibiae bright ochreous; tibial keels complete on the hinder tibiae save at the extreme proximal end, and extending for rather less than the distal half of the anterior pair.

Wings hyaline; pterostigma black, covering to 1½ to 2 cells; anal-loop made up of 9 to 10 cells; hypertrigones all traversed once; 1 cubital nervure in fore-wings, 1 or 2 in the hind; nodal index.— $\frac{7-14}{9-9}\Big|\frac{12-8}{9-9}$, $\frac{7-12}{8-7}\Big|\frac{21-6}{7-8}$; membrane brown.

Abdomen black; segments 2 and 3 with the ventral borders yellow, segment 2 with a broad middorsal citron yellow stripe extending its whole length and continued onto segment 3 as a fine middorsal line; the joint between these two segments also yellow. Segment 10 with a very long attenuated middorsal spine directed or sloping somewhat posteriorwards; no ventral tuft of hairs, present as in most other species. Genitalia not differing markedly from that of *I. saffronata.*

Female.—Abdomen 30 mm. Hindwing 30 mm.

Differing in but few respects from the male. The vesicle specialized, a broad short cone, its summit flattened and bearing a transverse sulcus in two directions which cuts it into four small tubercles, yellow the top metallic dark green. Wings deeply tinted with golden yellow at bases as far out as the 2nd or 3rd antenodal nervures and discoidal triangles; anal-loop made up of 12 cells; nodal index.— $\frac{8-12}{10-8}\Big|\frac{13-7}{9-10}$; other details of venation similar to the male; abdomen black marked as in the male; vulvar scale not as prominent as in other species, rounded at margin.

Distribution.—Assam. The type is from Cherrapunji and is now in the Selysian collection. Paratypes of both sexes in the British Museum and my own collections.

The male is distinguished at once by the curious shape of its appendages as also by the face entirely yellow, thus differing strikingly from other species. From *I. carinata* Ris., from S. China, to which this species is closely related, the smaller ventral spine on the superior anal appendages and the long fine spine on the sides of the inferior appendage will serve to distinguish it. The female is distinguished from all other species by the flat topped vesicle bearing four small tubercles; in *carinata* the vesicle bears three tubercles, the middle one the longest.

Idionyx intricata Fraser.

Idionyx intricata Fras. Rec. Ind. Mus. Vol. xxviii, pp. 197, 198, 202, 203 (1926).

Male.—Abdomen 28 mm. Hindwing 30 mm.

Head.—Labium yellow; labrum dark ochreous, its borders bronzed brown, clypeus black, the anteclypeus with a small triangular medial yellow spot; frons dark metallic green; vesicle dark metallic bluish green; occiput black; eyes emerald green.

Prothorax blackish brown, yellowish laterally; thorax dark metallic green with a short vestigial humeral citron yellow stripe; laterally an oblique citron yellow stripe on the mesepimeron and another on the lower part of the metepimeron; beneath yellowish, the sclerites blackish brown. Legs blackish brown; tibiae yellow changing to reddish brown at proximal ends; tibial keels closely similar to those of the last species.

Wings hyaline; pterostigma black, covering 2 cells; membrane white at base, brownish posteriorly; anal-loop made up of 8 cells only; hypertrigones of forewings traversed twice, but once only in the hind; nodal index.– $\frac{6-13}{10-10}\Big|\frac{13-7}{10-10}$.

Abdomen black; segments 2 and 3 with the ventral borders broadly yellow; segment 2 has also a narrow bilobate middorsal yellow stripe; segment 10 with a prominent triangular middorsal spine but not tapered to a point as in *I. optata.* Genitalia not differing markedly from others of the genus.

Anal appendages black; superiors short and thick, compressed, broad at base and again at apex where the appendage expands into a flattened organ, shaped like a hand shorn of its fingers, save the stumps, of which four may be noted:—a robust spine at the inner angle sloping inwards and downwards, a second adjacent to the last, directed straight back and followed by a third which is a mere knuckle, lastly a fourth at the outer angle, a long robust spine directed straight outwards. The inferior appendage much longer and closely resembling that of *I. optata* but the lateral spines with a greater spread and larger, their inner margins crenulate, whilst the apex is curved strongly and steeply upwards.

Female.—Abdomen 31 mm. Hindwing 35 mm.

Closely similar to the male save for sexual characters and a few other points. Vesicle highly specialized, shaped like the dome of a pagoda, its tapering apex split into two minute points. Wings evenly, diffusely and deeply enfumed especially towards the apices, the bases tinted with golden-yellow as far as the distal ends of discoidal triangles; anal-loop of 10-11 cells; 2 rows of cells between the beginnings of *IA* and *Cuii* in the hindwings; pterostigma covering 2½ to 3 cells, black, longer than in the male; nodal index.— $\dfrac{8\text{-}14}{10\text{-}10}\Big|\dfrac{14\text{-}8}{9\text{-}11}$.

Abdomen similar to the male but markedly compressed as in the rest of the females of the genus; vulvar scales prominent, projecting in a beak-like manner.

Distribution.—Cherrapunji, Assam. A single pair in my own collection. The male is easily distinguished by the shape of its anal appendages which bear some close resemblance however to *I. optata*. From the latter, the short stouter middorsal spine on segment 10 will at once serve to distinguish it; it is also a much smaller insect. The female is quite easily identified by the unique shape of its vesicle. (In the original description, the two sexes were described apart but subsequently included under one name—thus 'Female unknown', and 'Male unknown', should have been erased but were overlooked when correcting the final proofs.)

Idionyx stevensi Fraser.

Idionyx stevensi Fras. Rec. Ind. Mus. Vol. xxvi, pp. 462, 463 (1924); Id. ibid. Vol. xxviii, pp. 196-198 (1926).

Male.—Abdomen 32 mm. Hindwing 33 mm.

Head.—Labium and labrum bright ochreous; clypeus black; frons and vesicle dark metallic blue; eyes emerald green; occiput black.

Prothorax brownish; thorax metallic bluish green or green, with a short bright citron yellow humeral stripe deficient on the upper half of dorsum, and the usual oblique lateral stripes, one on the mesepimeron, the other on the lower part and border of metepimeron; beneath yellow with a dark oblique metallic green stripe on each of the paired sclerites and a large spot on the unpaired.

Legs blackish brown; the two hinder pairs of tibiae yellow on outer surface, the anterior pair pale brown.

Wings hyaline, the extreme bases only tinted with golden yellow; membrane ashy white; pterostigma black, covering 1½ cells; anal-loop made up of 8 cells; nodal index.— $\dfrac{7\text{-}13}{11\text{-}9}\Big|\dfrac{13\text{-}7}{9\text{-}11}$.

Abdomen black; segments 2 and 3 yellow along the ventral border; intersegmental joints from 1 to 4 also yellow. Anal appendages black; superiors broad at base, tapering somewhat towards apex which is squared at the end, hollowed out below and presenting on the inner border a short curled digitate obtuse spine and a deep incision just distad of this; the apex bearing a tuft of coarse golden hair. Inferior directed horizontally back, broadly trifid, the apex not upturned save its extreme point; the lateral lobes robust, divaricate, upturned spines. Genitalia very similar to that of *I. saffronata*. Segment 10 of abdomen bearing a prominent triangular spine on its middorsum but not long and tapering as in *I. optata*.

Female.—Abdomen 33 mm. Hindwing 34 mm.

Closely similar to the male, differing only in sexual characters and a few minor points; vesicle simple, rounded as in the male; wings very broadly tinted with golden amber at the bases as far out as the distal ends of discoidal triangles; membrane pure white; pterostigma longer and narrower, covering 2 to 2½ cells; anal-loop made up of 9 to 10 cells; nodal index.—

$$\frac{7-13}{10-9}\bigg|\frac{12-8}{9-10}, \quad \frac{8-12}{9-7}\bigg|\frac{13-8}{7-9}.$$

Abdomen compressed markedly as in other species, black, marked as in the male. Vulvar scale similar to that of *I. saffronata.*

Distribution.—North Bengal, especially common in the Darjeeling district. I found it quite common at Mangpu during May; its habits, especially those of the female, were quite similar to those of *I. saffronata* which the female greatly resembles when in the air. The male is easily distinguished by the shape of its superior anal appendages, whilst the female with its broadly tinted wings, simple vesicle and short humeral stripe possesses a complex shared by no other species.

Idionyx nadganiensis Fraser.

Idionyx nadganiensis Fras. Rec. Ind. Mus. Vol. xxvi, pp. 427, 460 (1924); Id. ibid. Vol. xxviii, pp. 197, 198 (1926); Id. ibid. Vol. xxxiii, p. 447 (1931).

Female.—Abdomen 35 mm. Hindwing 35 mm. (Male unknown.)

Head.—Labium bright chrome yellow narrowly bordered with brown; labrum bright citron yellow narrowly bordered with black; clypeus black; frons and vesicle dark metallic blue; occiput black; eyes emerald green during life. Vesicle rounded, simple.

Prothorax brown; thorax brilliant metallic green marked with bright citron yellow.—a narrow clear-cut humeral dorsal stripe on the lower half of thorax, a narrow oblique stripe on the middle of mesepimeron and another on the lower half of metepimeron. Beneath yellow with an oblique stripe of black on the paired sclerites and a transverse one on the unpaired one.

Legs black; tibiae bright yellow on outer surfaces except the anterior pair.

Wings hyaline, very palely enfumed, the extreme bases only tinted with golden-yellow to as far as the cubital nervure or distal end of cubital space; pterostigma black, covering 2½ cells; anal-loop made up of 9 cells; membrane cinereous; nodal index.— $\frac{8-14}{9-9}\Big|\frac{14-7}{9-9}$.

Abdomen black, markedly compressed; segments 1 and 2 with the ventral borders yellow and the intersegmental joints between these and segments 3 and 4 narrowly yellow. Vulvar scales hardly visible in profile, extending beyond the apical border of segment 8.

Distribution.—At the top of the Nadgani Ghat, Nilgiri Wynaad, during August. Only two females are known of this rare insect, the type in the British Museum, and one other in my own collection. The specimens I have quoted in the Rec. Ind. Mus., from Coorg and Kanara are doubtfully identified and have the humeral stripe very poorly developed as compared to the type of *I. nadganiensis.*

It is to be distinguished from other species by the simple vesicle coupled with a well-developed humeral stripe. Except for the very restricted tinting of wings at the bases, this species closely resembles the female of *I. stevensi* from Bengal.

Idionyx selysi Fraser.

Idionyx selysi Fras. Rec. Ind. Mus. Vol. xxviii, pp. 197, 198, 201, 202 (1926).
Idionyx yolanda Selys, (Male) 2nd Add. Cordulines, Bull. Acad. Belg. (2) xlv (1878); Fras. Journ. Bom. Nat. Hist. Soc. Vol. xxvii, pp. 689, 690 (1921).

Male.—Abdomen 31 mm. Hindwing 30 mm.

Head.—Labium bright chrome yellow; labrum bright citron yellow narrowly bordered with black; clypeus steely black; frons and vesicle dark metallic blue; occiput black; eyes emerald green during life.

Prothorax brownish; thorax metallic green marked with bright citron yellow: a short humeral stripe extending up the lower third or slightly more of dorsum of thorax, an oblique rather broad stripe on the middle of mesepimeron and an equally broad stripe on the lower part of metepimeron; beneath yellow, the paired sclerites broadly bordered with bluish metallic stripes outwardly. Legs black, all tibiae bright citron yellow.

Wings hyaline, only a faint tint of yellow at the base of the hindwings; pterostigma black, covering less than 2 cells, short; anal-loop made up of 8 to 9 cells; occasionally 2 cubital nervures in the hindwing; nodal index.—

$$\frac{6\text{–}12}{8\text{–}8}\left|\frac{12\text{–}6}{9\text{–}7}\right..$$

Abdomen black, segments 1 to 3 broadly bright yellow along the ventral borders, and with a fine stripe along the middorsal carina which broadens considerably on segment 2. Segment 10 with a robust middorsal carinal spine which rises steeply up and is variably yellow in part or whole.

Anal appendages black; superiors very long, nearly as long as the last three segments of abdomen, narrow, slightly sinuous and slightly tapered, the extreme apex abruptly turned down at a right angle and pointed; inferior of the same length, very narrow and long as compared to other species except *I. dohrni* and *montana*, the extreme apex tapered to a needle-like point and curled strongly up and over; the usual lateral spines situated very near the apex and very small and inconpsicuous in character. Genitalia very similar to other species of the genus.

Female.—Abdomen 27 mm. Hindwing 30 mm.

Closely resembles the male save for sexual characters; the yellow markings more conspicuous and extensive, the humeral stripe tapering to a point above and nearly extending to antealar sinus; the lateral stripes broader and the underside without its bordering black or with a mere line of this colour. Abdomen with the yellow middorsal stripe on segment 2 very broad especially near the base; this segment remarkably expanded on the dorsum immediately apicad to the jugal suture (There is a suggestion of this in other species but not to the extent seen in *selysi*); segments 7 and 8 with the middorsal carina bright yellow. Vesicle quite simple as in *I. stevensi* or *nadganiensis*, rounded.

Wings only slightly tinted at the base, but little more so than in the male; pterostigma not much longer than in the male; anal-loop with 9 cells; only a single row of cells between the origins of *IA* and *Cuii* in the hindwings; nodal index.— $\frac{6\text{–}13}{8\text{–}9}\left|\frac{13\text{–}6,}{8\text{–}7}\right.$ $\frac{6\text{–}15}{8\text{–}10}\left|\frac{14\text{–}6}{10\text{–}8}\right..$ Vulvar scale similar to that of *I. saffronata*.

Distribution.—The male, described as the male of *I. yolanda* by Selys, from the Karen Hills, Upper Burma, is now in the Selysian collection. One pair, the type and allotype, in the British Museum, and one male and two females in my own collection, are all from Maymyo, Upper Burma, collected by Col. F. Wall in June and July. This species is remarkable for the broad extent of its yellow markings especially the humeral stripe in the female and the abdominal markings. The male is easily distinguished at a glance by the long yellow dorsal spine on segment 10 as well as by the shape of the anal appendages. (These latter are very similar to those of *dohrni* and *montana* but neither of these have the dorsal spine on segment 10.) The female is distinguished by the long clearly defined humeral stripe and dorsal markings on segments 7 and 8.

EXPLANATION OF PLATE I.

Anal appendages of the males of.—

1. *I. minima* Fras., lateral view.
2. *I. galeata* Fras., lateral view.
3. *I. travancorensis* Fras., lateral view.
4. The same dorsal view.
5. *I. minima* Fras., dorsal view.

6. *I. saffronata* Fras., dorsal view.
7. *I. burliyarensis* Fras., lateral view.
8. *I. saffronata* Fras., lateral view.
9. *I. unguiculata* Fras., lateral view.

(Camera lucida studies drawn to the same scale.)

EXPLANATION OF PLATE II.

Anal appendages of the males of.—

1. *I. stevensi* Fras., lateral view.
2. *I. intricata* Fras., lateral view.
3. *I. optata* Selys, lateral view.
4. *I. intricata* Fras., dorsal view.
5. *I. galeata* Fras., dorsal view.
6. *I. optata* Selys, dorsal view.
7. *I. imbricata* Fras., lateral view.
8. *I. corona* Fras., lateral view.
9. *I. selysi* Fras., lateral view.

(Camera lucida studies drawn to the same scale.)

TIGER SHOOTING IN BURMA.

BY

W. S. THOM.

(*With 2 plates*).

It may be presumptuous on my part to write about tigers when such a very great deal has already been written on this subject by many well-known sportsmen who have accounted for large numbers of these animals in India, where they abound. I trust nevertheless that I may be pardoned for adding my modest quota of observations on Tigers and tiger shooting, as it is to be obtained in Burma. It does not necessarily follow that a man who has shot his 100 or more tigers from a machan, in a beat or, off the back of an elephant knows more about them than the sportsman who like myself has shot a modest 55 of them on foot as well as from a machan at night and who has studied their habits carefully for many years.

I am not prepared to say that tigers are so plentiful in Burma as in India. If, however, the sportsman will take the trouble to look for them in the proper way he will come across them in plenty. They are certainly not so get-at-able here nor are they so easily located as in India.

As trackers and shikaries for marking animals down, the natives of India are I think, perhaps on the whole more persevering workers than are Burmans. *Baksheesh* has, I dare say, a good deal to do with this. Rupees tempt the former more than the latter who are not by any means money grabbers. But when it comes to tracking up bison, rhinoceros, tsaing and elephant, I think the Burman can hold his own with any tracker in the world. Some of the Burmese hunters and trackers employed by me in Upper Burma in the Momeik State of the Ruby Mines and Thayetmyo districts, seldom failed me in following a trail to a successful finish. Among them was Maung Tha Yauk of Kadaing village, Mindon, of Thayetmyo district, to whose peerless skill and fearlessness I owe many a grand day's sport, the memory of which will be with me when my time comes to enter the unknown. All my hunters have joined the vast majority and passed to the bourne of silence from whence none return. If so be that the power is given them, may their spirits be permitted to repass that bourne and to wander afield after the lordly denizens of the jungles they knew so well, when they roamed this earthly world with me.

Owing to the uninhabited state of many parts of the country and the absence of large herds of cattle, tigers in Burma confine their depredations to hamlets situated usually at the foot of ranges of densely wooded hills like the Yomas or in the midst of large tracts of virgin forest or low-lying bush jungle. These wooded hills and stretches of grass jungle and forests in Burma were teeming to such an extent with game when I first came to Burma in the eighties that tigers obtained a full meal whenever they required it without coming down to harry the small herds of outlying villages. In India tigers are attracted to the neighbourhood of villages by the large herds of cattle on which they levy a big toll from time to time. The country being on the whole thickly populated, native hunters find it an easy matter to keep an eye on likely patches of jungle and mark down tigers till some 'sahib' willing to pay for the information, comes along. Burmans unfortunately rarely take the trouble to give information when any of their cattle have been killed. They generally prefer to cut up the animal at once and sell or eat the meat. In some districts, tigers play great havoc with buffaloes, bullocks, ponies, pigs, mules and even goats. Tigers are rarely walked up on foot in Burma; whilst organized beats for them with beaters and elephants are seldom undertaken for the simple reason that the jungles in most places are generally too dense and a sufficient number of staunch elephants and beaters are not available. If you are lucky you may have a tiger driven out to you in a beat by Burman beaters who have started originally with the intention of only beating for pig, sambar, barking deer, peafowl and junglefowl. The Burman hunter, owing to inexperience in this kind of work is not particularly keen about beating out a tiger. When it is known that one of these animals is likely to appear in a beat he naturally enough fears having to face the brute should it break back after being wounded.

Then again he is somewhat superstitious. In the jungle a Burman hunter will only refer to a tiger as '*saya*' i.e. the 'master'. He does not refer to the animal as '*kya*' i.e. tiger, but mentions any other name in preference. There are many things one may not do when out shooting in the jungles of Burma with Burman hunters. For instance, it was not considered correct in my time when after big game in the jungles of the Momeik State, Ruby Mines District, for a man to lay himself out at full length on his stomach to drink at a stream when the water could be drunk from the hollow of the hand or out of a bamboo. When eating a cold roast chicken in nature's way in the jungle, it was considered by my hunters unlucky to lay hold of a leg with both hands. It could, however, be held in one hand when eating. If you shot any animal the tip of its tail, or perhaps the tips of its ears or tongue, or sometimes all four portions were tied up to the stem of a bamboo or branch of a tree to propitiate the spirits of the woods after a 'mantrum' of a few words had been mumbled by the person who performed the operation. This was to bring good luck in getting the sportsman a good bull bison, or a good tusker elephant that day, or the next. If these offerings were not made, bad luck might attend the party.

However, unsporting it may seem, the usual method of bagging tigers in Burma is by sitting up in a 'machan' erected in a tree over a kill, i.e., a live or dead bait, such as a cow or a buffalo. Kills or baits are more expensive in Burma than they are in India.

In Burma in the majority of districts they may cost anything from Rs. 15 to Rs. 30. Besides a Burman is usually a good Buddhist so it is often impossible to obtain a bait unless it is the carcase of some animal that may have been dead some days, or happened to have died, or to have been killed by a tiger just as the sportsman arrived in the vicinity. I invariably undertook to give the owner of the cow the Government reward, viz., Rs. 40 for the tiger should I succeed in shooting it from a 'machan'.

No suitable electric contrivances were available in my day when I shot my tigers. I regret to say I haven't any flashlight photographs of tigers to illustrate this article, such as the really wonderful pictures taken by Messrs. Champion and Peacock and reproduced in the respective books recently published by them. More than half the tigers killed by me were shot on foot.

Some people think that it is not very sporting to shoot a tiger from a 'machan' whilst sitting up over a 'kill' during the night or in the day. This subject has been discussed *ad nauseam* but perhaps I may be pardoned for adding my humble opinion to the rest. It seems to me that shooting a tiger over a 'kill' from a machan in a tree at night is no less sporting than it is to shoot a tiger in safety from the back of an elephant, or one that has been driven up to the guns posted high up in trees in a beat during the way. It has been done and is being done daily at the present time in India but not in Burma. It may be argued again that a tiger when fired at, at night from a machan is more liable to go away wounded than when driven up to the guns posted in trees, by elephants and beaters in broad daylight or when fired at from the back of an elephant. I have never done any shooting from the back of an elephant and never want to do so, knowing nothing about it. I did try it many many years ago but found it so tedious and unsatisfactory that I gave it up. It seems to me nevertheless that driven tigers are just as likely to get away wounded when fired at by the sportsman posted on a tree, or when walked up and fired at from the back of an elephant, as when fired at, approaching, or standing at a 'kill', by a sportsman seated up in a machan at night. An inexperienced sportsman, or an indifferent shot might make a mess of things of course wherever he might be. But it should not be forgotten that a tiger driven to posted guns often travels fairly quickly or slinks away through bushes, when only a fleeting glimpse of him is obtained. He does not therefore present as good a target as would be given to any one posted on a machan at night, who usually nowadays has the advantage of an electric contrivance with which to draw a bead on the animal at a range of generally not more than from about 15 to 20 paces. There are also occasions when tigers have been shot from a machan before the sun has set. Then, last but not least, it should not be forgotten that sitting up over a kill for a tiger is usually the only method available to the sportsman in Burma or to the poor man in India, who cannot arrange for a long line of beaters or elephants. A tiger has, I suppose, a better chance of escaping with his life when fired at by a sportsman, seated, shall we say on the pad of a moving elephant, than he has perhaps when he is driven towards a sportsman seated on a machan up a tree, or when fired at from a machan at night over a 'kill'. I dare say just as many tigers have been fired at, wounded and lost by sportsmen shooting off the back of an elephant, as from a tree in a beat, or from a machan at night. Ultimately, one is led back to the question as to which method is the most humane and sporting. That is not an easy question to answer, as every one has his own opinions on the subject.

I cannot agree that sitting up for a tiger on a machan at night with an electric contrivance is unsportsmanlike. I have never done so myself because I never had an opportunity of using an electric contrivance, but I see no more harm in doing that than in shooting at a tiger from a 'machan' with a good moon in one's favour. With an up-to-date electric contrivance a tiger has less chance of getting away badly wounded. In case of a tiger being fired at and wounded, the correct and humane thing to do is of course to follow the beast and finish it off. If possible, this should be done not only to prevent the animal dying a lingering death but because a partially disabled tiger with a leg or shoulder shattered might become a maneater through not being able to pull down game or village cattle, as before. It is very easy to point out one's duty in this respect and say that wounded tigers should always be followed up and finished. It is all very well when one can do it riding on the back of an elephant, or can so manipulate a herd of buffaloes as to keep them between one and the tiger when he charges. It is the devil when one has neither one nor the other at one's disposal and one is finally egged on to proceed on foot by the thought that at any moment the animal is sure to be found lying stretched out dead. Everything depends upon where the tiger has been hit. If the bullet has been placed too far back and only gone through his intestines, like bison, a tiger will often survive several days and will be a devil incarnate before succumbing to a body shot. It should be borne in mind that a tiger when mortally wounded rarely utters a sound, except perhaps to emit a faint groan, or grunt, but, an animal that has had, say, a leg broken, or a hit on some other non-vulnerable spot, where the bones may have been badly damaged, invariably utters a succession of short angry grunting snarls or roars. There is no mistaking the noises made by an infuriated, wounded charging tiger that means business, and intends getting home on to some one. Once heard, they will never be forgotten. Hearing those awful hoarse, coughing roars, one feels as if one's bowels, in Biblical terms, had turned to water.

The great thing to remember in tiger shooting is that the bullet should be a big and heavy one with a fairly large charge of powder behind it. It is all very well shooting at a tiger from a machan with a small bore rifle or a 12-bore shot gun, burning say 3½ drachms of powder and taking a spherical bullet, when one is 15 or 20 feet off the ground. One may be lucky with one's first shot from the tree, and kill the beast, but unless equally lucky one would be courting almost certain death to fire at the animal when on foot on the ground. 3½ or even 4½ drs. of black powder or its equivalent charge in smokeless or cordite, hardly gives sufficient penetration. Moreover the feeling of confidence in being up a tree makes one hold much straighter than one would ordinarily do facing the tiger on foot. An experienced European shikari, who it seems to me was lucky to escape death, followed up and faced a wounded tiger armed only with a ·280 Ross rifle.

There was nothing in the old days to beat the good old magnum ·577 black powder rifle which burnt a charge of about 7 drs. of black powder. The heavy, soft lead bullet of this rifle, when it acted effectively, usually mushroomed and, after passing through the body and doing a lot of damage in its course, was held up from passing out by the skin on the outer side. Of course there would be occasions also when the bullet passed clean through the animal's body after mushrooming and doing much damage.

Some men swear by small bore high velocity magazine rifles such as a ·318, ·280, ·303, ·276, ·240 or ·256 because they are light and easy to carry whilst the trajectory is also low. Bell, the author of 'The wanderings of an elephant hunter', shot all his elephants and lions in Africa with one or other of the small bore-rifles mentioned above; whereas Sutherland, who shot over 500 elephants in Africa used a double ·577 cordite rifle. A rifle that is suitable for dispatching an elephant, rhinoceros, bison or buffalo is also required for killing a tiger. A high velocity ·500, ·475, ·465, ·470 or ·450 bore cordite rifle burning between 70 or 80 grains of cordite would be quite suitable to use on a tiger whether on foot, on the back of an elephant, or on a machan. I personally would just as soon use a Westley Richard's double ·12 bore magnum Explora cordite gun at close quarters on a charging tiger. A double barrelled ·577 hammerless ejector cordite rifle burning a 100 grains of cordite might be of use in the hands of some sportsmen for tiger, but I should relegate it to its proper place, namely for use say, on a solitary tusker elephant, bull gaur, rhinoceros, buffalo, or tsaing, when a picked shot can be taken or when one of these animals was charging. But it is a deuce of a weapon to have to carry any distance when the thermometer registers 95 or 100 degrees, although in the old days I used to think nothing of carrying a heavy black powder ·8 bore 'Paradox' burning 10 drs. many a mile over steep and broken ground. The ·577 if held straight will usually knock out most animals although I have had it fail me on two separate occasions on solitary bull bison.

Can it be said by any one that there is not fascination or excitement enough in sitting up in the jungle, alone with nature and a full moon, far away from any village or human being waiting for a tiger to put in an appearance? Can any one swear that his pulse and heart does not beat faster or that his senses are not stretched to their utmost tension on hearing the sounds of a breaking twig accompanied by the subdued sniffs which are sometimes emitted by a tiger as he cautiously pushes his way up to the kill? If he cannot experience all these feelings then, all I can say is that he need not imagine he is a sportsman in the sense that I mean. I do not believe in the calm phlegmatic sportsman devoid of all nerves or any sense of excitement. There are quite a number of men of this description nevertheless, who do not experience any sensation in the jungle. I have known others who having sat up for a tiger have not had sufficient guts to fire at the animal when it did put in an appearance, or, who were so shaken that they made the machan creak so badly as to cause the tiger to take alarm and make off. Captain F. C. Selous, the famous African hunter, and I believe the original of Rider Haggard's *Allan Quatermain*, who was shot dead at the head of his company in East Africa during the war when he was over 60, although of a quiet undemonstrative disposition was yet possessed of any amount of quiet fiery nervous energy and pluck. He was known to be one of the keenest sighted and quickest observers of his time in the jungle. There is no doubt that a long sojourn in the jungle when one is continually tracking up and coming in contact with large wild dangerous animals sharpens a man's wits and senses to a very great extent. I trust I may be pardoned for remarking that I found from a lengthy experience in the jungles of Burma that all my senses of sight, hearing, smell, taste and touch, soon became very highly developed. I could also walk through the jungle as lightly as a cat and still be able to see everything ahead and all around me without treading on a leaf or snapping a twig. Then again my sense of direction also became almost as good as some of my trackers.

Considering Selous had done so much big game shooting in other countries, it had always appeared strange to me why this noted sportsman never came out to India or Burma to shoot tigers or the lordly gaur, the largest of all the bovines in the world, not to speak of the tsaing or banting (*Bibos banteng birmanicus*) and the brow-antlered deer (*Rucervus thamin*) none of which he had ever seen, and which are only to be found in the East. It was only when I was last at home in Scotland in 1897 after being introduced to him at Perth by Sir Scott Montcrief after a lecture given by Selous that I learnt his real reasons for not visiting India or Burma to shoot. During the course of a long conversation I had with him on shikar he informed me that the reasons which had deterred him from visiting India or Burma were that he was married for one thing, and was moreover growing old, whilst he was not a rich man. He told me then also that he was collecting specimens for museums and wealthy men owning collections such as the Rothschilds and others.

Among several of the tigers bagged by me in Upper Burma was one I accounted for at a place called Nanyaseik in the Myitkyina District, a place once famous for its big game, now somewhat thinned out by the Kachin, Burman, Shan and Gurkha hunters.

After a hard morning's work with bison—there was a big bull in a herd which I had to my disgust missed most disgracefully—, I was just stepping out of my bath preparatory to having breakfast, when the Gurkha caretaker of the Nanyaseik Public Works Department bungalow came galloping along on his pony up to my camp and after dismounting shouted out to me in a great state of excitement that a tiger had killed a cow that morning close to the village and was still feeding upon the carcase when he left Nanyaseik. It was then about 10-30 a.m. The poor man had come along at such a pace that he had fallen off *en route* and barked himself badly in two or three places. As I was on my way to Nanyaseik to inspect a Police outpost there, the 'Khubber' suited me down to the ground. On my arrival at the village at about 2 p.m. I learnt that no one knew anything about the animal or kill but that a Shan on his way home early that morning, when within about five or six hundred yards of Nanyaseik village had seen the tiger which had sprung backwards and forwards across the road in front of him several times and had then disappeared. The Shan it seems thinking the animal meant mischief had drawn his long fighting 'dah' out of its sheath to defend himself, and had then bolted for the village after uttering a shout or two to frighten it away. This had the desired effect for he did not see it again. I now learnt also that an old emaciated cow belonging to no one which used to wander round the village had at last dropped down from sheer exhaustion and old age. It was lying helpless in a small clump of plantain trees situated within about 40 yards of the village and about three paces from the high road along which the Shan had been travelling when he encountered the tiger. The whole affair had been grossly exaggerated and I saw at once what had really happened. The tiger had evidently been on his way to stalk and kill the cow when the meeting with the Shan disturbed him and put an end to his plans. The encounter had evidently displeased the tiger who had shown his displeasure by acting as he had done. The villagers and the durwan or caretaker of the bungalow on hearing the Shan's story had at once taken it for granted that a cow had been killed by the tiger, and, although it was broad daylight when the affair took place, and there was a gun in the village belonging to the headman, no one thought for a moment of going out to see whether the cow had or had not been killed. I settled the matter when my pack mules turned up with my kit and guns by going and seeing for myself. It is marvellous what confidence is inspired in these villagers by the presence of a white man. Although they kept at a respectable distance behind me, some 20 villagers in all accompanied me to the scene of the supposed kill. Here I found the cow lying down untouched, and of course there were no signs of the tiger. The unfortunate animal it seems from enquiries made by me on the spot, had, for the past two days, been left lying helpless where it had fallen, in the blazing sun, without either food or water. It is against the Buddhist creed of course to put an animal out of its misery by killing it, or indeed to take any life at all except in self-defence, so I killed the poor brute myself as mercifully as possible by shooting it and then had it disembowelled and its throat cut. This sounds rather gruesome I will admit, but it was necessary to have the scent of fresh meat and blood wafted abroad north, south, east and west so as to attract the tiger as soon as possible as I had no time to spare.

As it was full moon that night, and there was some possibility of the tiger turning up, I decided to sit up in a machan over the carcase of the cow as soon as the villagers erected one for me. A small rickety platform of bamboos was accordingly erected by the villagers at a height of only about 10 feet from the ground in the centre of three or four plantain trees which stood within about 15 feet of the spot where the carcase lay. My instructions regarding the erection of a proper machan had not been followed much to my disgust. A Burman of course will sit on the branch of a tree and wait all night for a shot at anything without feeling fatigued. The Shans in the locality did not apparently know anything about the erection of a 'machan' and did not understand what I really wanted, so I had to sit on a single platform. I went back however to the village I was camping at for a cane 'morah' or stool and laid a rug over this. That made matters a little easier for me, but of course I was by no means as comfortable as I might have been had two platforms been erected. I usually made a point of having a machan made of the green boughs of trees, as if bamboos are used they invariably creak when any movement is made on the machan, which would be sure to scare away the tiger or keep it from coming up to the kill. I also preferred a double platform, one above the other as it were, about 2' 6'' apart. Each platform would also be 7' long by 4' wide. This enabled me to sit on the upper platform and rest my feet on the lower one or I could lie down and rest on the upper one when I wanted to, and stand on the lower one when necessary, so as to enable me to turn round and shoot at the tiger in an erect position from any direction over the parapet of leaves, usually erected round the sides, front and back of the machan to shield the hunter from being seen. I also invariably wore rubber shoes and had a dhurrie or rug laid on each platform to deaden any sound I might make when I moved about on the machan. I found a rope ladder very useful for getting into the machan from the ground. I never as a rule sat on a machan at a lower height from the ground than 15 or 20 feet. That is really the minimum height one should be installed from the ground. Charpoys and ready-made machans can also be obtained and put up in a very short time. A good double platform machan takes several hours to make properly and at least 8 or 10 men are required to carry out the work. I might mention here for beginners that villagers who have been deputed to erect a machan over a kill should see that all the material is cut at some spot a good distance away from the tree on which the machan is to be built. The work should be done with as little noise as possible so as not to disturb the tiger should it be lying up, as they often do, near the kill. Then again, if the erection of the 'machan' has for some reason been delayed till a later hour, say sunset, the villagers, after they have completed the erection of the 'machan', should return to the village talking, laughing and singing, so that the tiger, should he be in the vicinity, may hear them, and imagining that all was well turn up at the kill at an earlier hour than he would ordinarily have done.

All the split bamboo shavings or withes used for securing the machan, the cut boughs and branches and other odds and ends, left lying about on the ground near the 'machan', or near the kill, should be collected and hidden or taken away altogether a good distance from the machan. If this is not done a knowing tiger might after reaching the kill become suspicious on seeing all this rubbish lying about, rubbish that was not there when he was last at the kill, and clear off at once in consequence. I have however shot several tigers that have come up to the kill in broad daylight before 5 p.m. In fact some have started feeding at once without taking any notice whatsoever of the rubbish heaps that had been left lying on the ground in the vicinity of the 'kill' or the machan. Tigers do not as a rule like feeding on a kill that has been dragged into an open space near a suitable tree for the erection of a machan. I always made a point of having two large stout stakes driven into the ground for several feet and secured one at the neck and the other at the hind quarters of the kill. It is a good thing to take into the machan a small haversack full of stones with which to bombard the body of a tiger that you may have fired at and that may be lying within sight of the machan in order to see whether it has any life left in it. Some people say you must not smoke whilst seated on a machan waiting for a tiger to put in an appearance in case the animal should scent the tobacco smoke and not turn up. I doubt whether there is much in this. If the tiger can scent the tobacco smoke he can also scent the sportsman. It is much better sitting up alone for a tiger. I personally prefer being alone. My experiences of sitting up with Burmans is that they either go to sleep and snore, develop a cough, or want to clear their throats, which, as can be understood, does not facilitate the arrival of the tiger at the kill. It is better to wear a pair of long lose dark coloured flannel trousers, stuffed for choice at the bottom, into long soft leather mosquito boots with crepe rubber soles. The lower platform of the machan should have very strong stout branches well-laced closely together in such a way as to shut out any possibility of the tiger being able to force his way through it should he scramble up the tree in an attempt to get at and claw the sportsman off his perch, a thing which tigers are capable of doing and which has been done in India on several occasions. One has only to watch a cat scramble up a tree to a considerable height when frightened or chased by dogs to understand this and after all a tiger is nothing more than a large cat although a very dangerous one. I could go on *ad infinitum* and mention other tips useful to the beginner in the jungle, only I should be afraid that my readers would be bored stiff if they have not already reached that stage. I shall risk it however, and only refer to one more tip which will certainly be the last. Sometimes one is belated in the jungle through having covered more country than one intended doing and finds on one's return in failing light that the fore-sight cannot be seen very clearly it being only, shall we say, a fine black bead. One then meets a tiger, which, under these conditions, if one is wise, is not fired at. Messrs. Westley Richards the well-known gun and rifle makers invented a black metal sheath with a white circular porcelain or enamel bead fore-sight which can be slipped on at once and is easily seen in fading light when the ordinary black bead would be more or less invisible. If I mistake not, there is a set of four of these slip-on night sights made, graduated from the size of a large pinhead to one the size of a pea. They cost about half a crown the set. Some makers call them gloaming enamel fore-sights. Messrs. Manton & Co., Calcutta, I know keeps them in stock. For a young man with good eye-sight an ordinary fine black bead fore-sight is good enough during the day except in failing light, when one of the above mentioned slip-on sights would be required. For a sportsman like myself who is nearing his seventies, a platina, platinum or German silver bead fore-sight (these three sights are pretty nearly all alike in appearance) would be preferable. It is more easily seen than a black bead fore-sight especially when one is using shooting spectacles. Ivory-tipped fore-sights wear more rapidly, and are more easily broken. As a matter of fact the sportsman should have a spare fore-sight for each rifle in case of accidents and it should be possible to screw these on without much difficulty.

I must apologize for this lengthy digression. The majority of the suggestions made by me are all well known to experienced sportsmen and are probably considerably out of date in the opinion of some. However, they may be of some use to the sportsman who has not accounted for a tiger and is keen on doing so.

To come back to my tiger, taking a revolver and my 12-bore 'Cosmos' ball and shot gun built by Cogswell & Harrison to burn only 4½ drs. of black powder and throwing a heavy conical bullet, the only suitable weapon I had with me at the time, other than a heavy 8-bore rifle I entered the machan alone at 6 p.m. At 7-30 p.m. the moon having risen well above the tree tops in a cloudless sky everything was brilliantly illuminated. Drops of shining moisture, the result of a heavy dew were now falling from all the bushes and trees around me with a steady patter. Suddenly from a neighbouring hillside away in front of me about a mile off where there was some very heavy cover I heard the roar of a tiger followed by others at intervals. These drew nearer and nearer, and then ceased altogether as the animal approached the village. She, for it turned out to be a tigress, was noted for the noise she made when she began her nocturnal prowls. I was only hoping fervently that she would come near enough to the kill to obtain a whiff of it. She turned up as a matter of fact much sooner than I expected taking me completely by surprise. About 8 p.m. while I was leaning forward staring vacantly at the kill, and dreaming of the past, my gun lying across my knees, I was thunderstruck at suddenly seeing on the other side of the kill, within a foot or two of it, a shadow, a something that was not there before, which vanished again as noiselessly as it had appeared. It was the tigress which had come and gone without so much as deigning to even sniff or look at the carcase, far less give me an opportunity of levelling my gun at her. I should have said that before disappearing she lifted her head and looked at me full in the face for a second. Whether she saw me or not or suspected something I am unable to say; at any rate she did not appear to be particularly hungry. It was marvellous how the colours of her coat blended with her surroundings and made her partially invisible when standing in front of me with a full moon overhead. Thinking that she might perhaps turn up again I waited for another hour. She did not put in an appearance however, so I descended from my perch, went to the village and to bed. My Madrassi boy on waking me in the morning with my tea and toast greeted me with the comforting news that the tiger had 'done finished' eating the cow, his way of putting it, that the tiger had had a meal at the carcase during the night. I was in the 'machan' again that evening alone at 6 p.m. determined not to be caught napping again. As a matter of fact 4-30 or 5 p.m. would be a better hour to get into the 'machan' than 6 p.m. as there is no knowing when the tiger may turn up. If the kill is far from any village it may turn up early, if it is close to a village and it is a sophisticated animal, it will not come before 8 or even 9 p.m. I have shot several tigers that turned up at the kill at 5 p.m. but these were kills situated several miles from any village. At 6-30 p.m. some way off from the edge of a neighbouring clearing I heard a jungle fowl get up with a cackle and fly away screaming. Some monkeys also which had been feeding close by kept up an incessant chatter till darkness set in when all sounds ceased. These were distinct signs that the tiger was afoot, for I knew that no villagers were about here. Although no roars were uttered this time she made no secret about her approach, for, at about 7-30 p.m. after the moon had been up some time, I heard her moving stealthily along the undergrowth towards the carcase. She did not hesitate once but came straight on being evidently quite unsuspicious of any danger. On reaching the body of the cow she sniffed at it once or twice and then suddenly throwing up her head directed a piercing glance at the 'machan'. Her yellow eyes appeared to be looking straight into mine. Appearing satisfied with her inspection she lay down on all fours and after making one or two determined efforts to remove the carcase which I omitted to say had been very carefully staked down, gave it up as useless, and then set to work and buried her teeth in the meat. I was determined to let her have plenty of time so waited fully five minutes during which she raised her head a number of times and listening to every sound that came from the village.

I should have stated that my gun was fitted with a large white flat circular porcelain night-sight about the size of a pea. This night-sight could be folded down flush with the rib of the gun when it was not in use, i.e., during the day, when the other bead fore-sight for use in daylight was required. I found this night fore-sight showed up very well when I had the moon at my back and I always made it a point when I did sit up at night in a machan to see that the machan was constructed in such a way that I could face the kill and the tiger with the moon at my back, for with the moon's rays shining in one's face it was almost impossible to see the night sight at all. Confound these digressions and old fashioned ideas and explanations I hear some one say. I trust nevertheless that I shall be forgiven for making them.

Finally I aimed for a point between her neck and shoulders and fired. A series of the most appalling snarls and roars followed my shot as she dived out of sight with a crash into the undergrowth some five or six paces from the kill. Here she rolled about roaring and snarling in a manner exceedingly trying to the nerves. From the sounds emitted between her growls she seemed to be alternately swallowing and ejecting mouthfuls of blood. As the undergrowth was about 5 or 6 feet in height here, I was unable to see any portion of her or else I would have at once put her out of her misery by firing again. It became apparent to me that she was fast getting into a comatose, and therefore harmless state. She had by now begun to breathe stertorously, the loud snoring noise being audible at a distance of at least 150 yards. I descended from my perch and got out on to the road where I joined the villagers who had turned up *en masse* armed with spears and 'dahs'. I was exceedingly puzzled to know where I had hit the animal and assumed that the bullet must have got her about the head somewhere and had then passed down her throat. Directing the villagers to make a big fire at a safe distance and let me know when all sounds ceased I went back to the bungalow and sat down to dinner. I had not been absent more than 25 minutes when my ears were greeted by a series of yells and cheers from the direction of the kill. Guessing what had happened I jumped up from the table sending my pudding of plantain fritters flying, seized my gun and was out of the bungalow and at the scene of the kill in a trice. As soon as they had heard the tiger's groans cease the whole village to the number of 20 or 30 hard turned out in a body during my absence with bamboo torches and lanterns. In spite of my warnings, they literally cut a passage through the undergrowth to the spot where the tigress, fortunately for them, lay dead. I found them all congregated round the animal, busily engaged jabbering away and measuring the beast. My bullet had caught her below the right eye, crashed straight through the base of the skull fracturing it slightly without damaging the brain, and then continuing its course through her mouth and throat lodged eventually in her hind quarters near the root of the tail. She had I suppose really died of suffocation, loss of blood and shock to the brain. The tape showed her to be only 8½ feet in length.

The circumstances connected with the shooting and bagging of a large tiger which measured 10 feet 4 inches, is the record for Burma, which was wounded and then followed up on foot accompanied by a few Military Police Gurkhas and Burmans, bring back very unpleasant recollections. They can never be erased from my memory for they resulted in the mauling and subsequent death of one of the Gurkhas with me at the time. I was then encamped at Sinbo, a village situated on the banks of the Irrawaddy in the district of Myitkyina. Information reached me that a tiger had killed a cow during the small hours of the morning at P. a village on the banks of the Irrawaddy about one and a half miles above Sinbo. Directing my clerk to send out word at once to the headman of P. to see that the carcase of the cow was not broken up and distributed amongst the villagers, I hurried through with breakfast and ordering only my pony to be saddled galloped out to P. with the object of superintending the erection of a machan with the view to sitting up for the tiger the same night. I found the cow lying in the jungle with its neck broken. It was some 20 to 30 paces from the cart track leading into the village which was distant from the scene about 150 yards. This tiger was evidently a noted cattle lifter for he had often been heard of in these parts and though he committed his last offence in such close proximity to the village no one heard a sound. He had evidently helped himself considerably in his first meal. Some big junks of meat probably 15 to 20 lbs. had disappeared from the cow's hind quarters. After turning out the villagers I had the carcase dragged out on to the road where, to begin with, I had it securely staked down to the ground. Most tigers dislike feeding in the open, and invariably move the carcase if they can, out of sight, into cover. As there was not to be a vestige of a moon during the night, and torches had not yet been invented, I was obliged to have the platform rigged up as low as possible to enable me to see anything at all. Owing to the absence of trees in the vicinity of the road it was necessary to have three poles inserted in the ground as supports in the shape of a triangle amongst the bushes by the side of the road. Upon these at a height of about eight feet a seat or double platform (such as has already been described by me in this article), large enough for one person only, was constructed. It faced the road and kill which lay in the centre of the road way. After seeing the machan completed a matter of about three hours' hard work I cantered back to Sinbo and after bathing, changing, and having some tea, galloped back to P. and entered the machan alone at 6 p.m. I had not been seated in the machan ten minutes before I heard the tiger 'titting' from a neighbouring plantain grove about 150 yards or so from my machan. Carts and buffaloes were still passing at the time along the road on their way back to the village from work. This tiger which had evidently never been fired at before was a noted cattle lifter. He just used to walk up in broad daylight, help himself to a good fat heifer and then walk off again. He was evidently a greedy animal and was in a devil of a hurry to get back to his 'kill', but he did not like hearing all this traffic viz., the creaking carts and the loud knocking sounds emitted by the hollow wooden clappers or bells worn round the necks of the buffaloes, also the noise of the commands which were issued by the cartmen to their bullocks. The tiger knew perfectly well that these noises were being made near his kill and he did not like it at all, so gave vent to his anxiety, impatience, suspicion and perhaps annoyance, by uttering there 'titting' calls. These calls or 'tits', which is a Burmese expression, are almost exact imitations of the bells of a sambar that has been disturbed, except that they are sharper and shorter.

I trust I may be pardoned for referring to this subject again and that the Editors of the *Journal* as well as the readers of this article will forgive me for being so egotistical as to lay claim to being, I believe, the first European sportsman to bring forward a suggestion that the true reason for a tiger making these 'titting' calls was that it does so on being disturbed suddenly by human agency. To begin with it is not a call from one tiger to another, or in other words a mate call, for in this case I am quite convinced there was no mate in the vicinity. I have moreover heard these calls, uttered by tigers on no less than twelve different occasions in Burma, when the animals that made them, had either been shot at and missed, or had been disturbed suddenly when at the kill or in some other way by human agency. On each, and every occasion, there was certainly no mate. An article by me on this subject entitled 'Notes on tigers and their calls', will be found on page 548, vol. xxix, No. 2, dated 25th August 1923 of the Bombay Natural History Society's *Journal* where my views on the subject are clearly stated. On pages 462 and 463, vol. xxx, No. 2 of the same *journal*, dated 25th January 1925 will also be found an article by Major James on the same subject. Mr. Dunbar Brander also discusses the matter on page 905, vol. xxx, No. 4, dated 15th December 1925. He states however that the origin of the call has to do with a mate. I am afraid I cannot agree as to the supposition that the sambar is lured to his destruction by the tiger's mimic bell or 'tit'. Why should a tiger, monarch of all he surveys in the jungle, with eye-sight, hearing, strength, agility and speed beyond compare, and who has little or no difficulty in procuring a meal at any time have recourse to such deception. Mr. Peacock calls a tiger's 'tits' a note of surprise. He might add doubt, alarm, suspicion and apprehension, but I suppose these after all amount to the same thing.

The Editors of the Bombay Natural History Society's *Journal* in summing up the matter on tigers' 'titting' were, I flatter myself inclined to take my view of the matter, namely, that these 'titting' calls are made by the animal when it is in doubt, or has been thoroughly alarmed by human agency. Even if two tigers, which are mates had become separated through having been disturbed by human agency and were 'titting' together at intervals, it seems to me quite clear that they were 'titting' not necessarily to let each other know the other's whereabouts, a thing surely that any tiger could easily ascertain in no time by instinct alone, as indeed could most wild animals, but because they had both been alarmed and were on the *qui vive* and were perplexed and upset, or suspicious regarding the situation. I heard a tiger calling or 'titting' incessantly round our camp on the Lemro River in Arakan one night, after Walker, D. C. Forests, had shot a tiger over a kill which I had tied up for him about a mile from camp. The tiger was shot at about 8 p.m. and the 'titting', whether made by the dead animal's mate or by another animal, it is impossible to say, began in the vicinity of our camp the same night at about 10 p.m. We left the carcase of the tiger lying on the ground, after the skin had been removed, about 150 yards from the bamboo huts we were camping in. There was no doubt that this 'titting' tiger was alarmed not only by our camp being where it was but also probably because of the smell of the carcase of the dead tiger. Our camp had been constructed on both banks of the Lemro River in such a way as to block (not intentionally) the passage of any animal coming up or going down stream, along the banks of which a regular cat walk for tigers existed. The animals could not make a detour at this particular spot as the hills were much too precipitous on both sides. Even if the 'titting' animal was attempting to call up its dead mate it was a note indicative of suspicion and alarm. Shortly after my article in the Bombay Natural History Society's *Journal* appeared putting forward my views as to the reason for tigers making these 'titting' calls, a gentleman writing anonymously from Mandalay, who had seen a similar article of mine in the *Rangoon Gazette* prior to the one published in the Society's *Journal* on the subject of tigers' 'titting', which by the way is a much nicer word than 'pooking', wrote as follows to the *Rangoon Gazette*. 'For the information of your correspondent W. S. T. (which are my initials) whose interesting article "A few notes on Tigers and their calls" appeared in your paper dated the 12th July, 1923, the well-known Burmese proverb "Lu-kyauk-yin-hit-the,-kya-kyauk-yin-tit-the," will tell W. S. T. or any one who is in doubt as to the cause of tigers "tittings", that tigers "tit" only when they are alarmed or frightened.' The literal translation of the proverb means 'when a man is suddenly startled he makes an exclamation like "hit-the" and when a tiger is startled suddenly he "tits".' I was not aware till the Mandalay note (which I subsequently learned was written by the late Lt.-Col. H. H. Harrington, 62nd and 92nd Punjabis, a well-known ornithologist and an authority on the birds of Burma) appeared in the *Rangoon Gazette*, that any such Burmese proverb existed. This would therefore bear out my contention that a tiger only 'tits' when alarmed or suspicious and that it has nothing whatsoever to do with a mate call.

Although I trust I will not be accused of appearing to be tedious on this subject I will drop it for ever after giving one final instance of a tiger 'titting' on being suddenly alarmed.

I was sitting on the banks of the Lemro River in Arakan one night at about 9-30 p.m. about 100 yards or so above our camp after dinner, smoking and talking with Walker of the Forests. A tiger, which, judging by its tracks, had been walking down stream along its usual beat on the side on which our camp stood, there being no villages for miles around, almost walked into Walker and myself before noticing us. On suddenly discovering our presence from a distance of only about six yards, a bunch of rocks having hidden us from view, it dashed away up the steep bank above us sending a stream of gravel and small stones hurtling down upon us. Then, from the jungle above us, it made the welkin ring at intervals, with its short, sharp, nervous bells, or 'tits' of alarm. I am afraid however I have made a very long digression so let me get back to the tiger I was sitting up for.

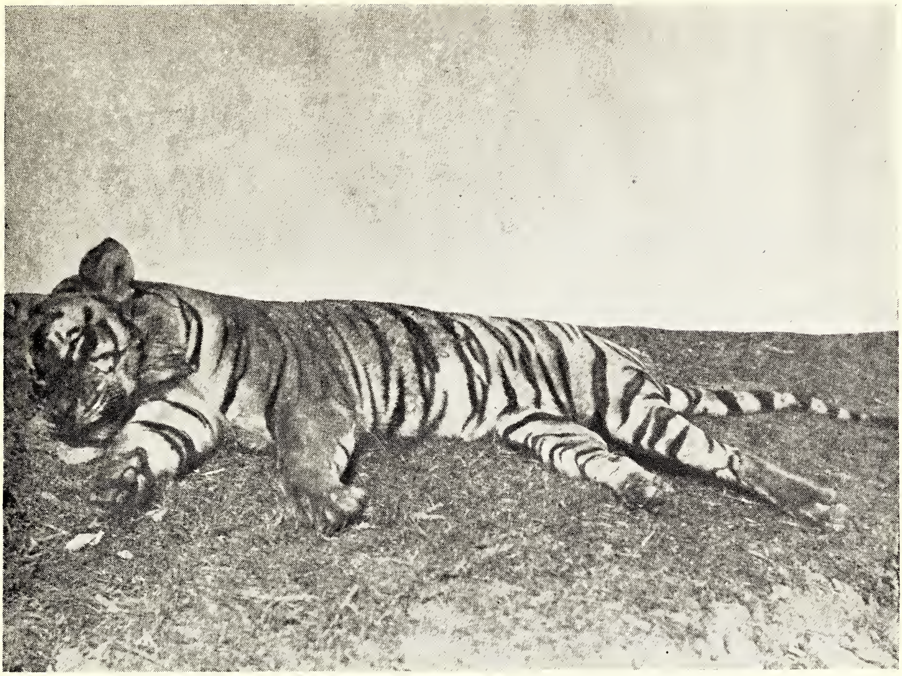
All noises gradually subsided as the light faded and the stars came out one by one. I was attracted at first by hearing some harsh grating, purring sounds from the jungle behind. They appeared to be drawing nearer and yet nearer. I listened, my heart pounding like a sledge hammer, and peered down steadfastly at the kill which I could just see dimly lying out along the bare portion of the road not more than 12 to 13 paces from where I was seated. At first I thought they were leopards but they turned out to be hungry jungle cats which, having scented the dead cow from afar, were dying to get within eating distance, but dared not knowing full well that it was the kill of the dreaded midnight prowler and that if he found them there it would be all up with them. These animals were moving fussily round the kill for a long time, making a great show of coming right up to it for a mouthful. But they could never screw up enough courage to do so. Suddenly they scurried away in a terrible hurry and disappeared for good. I was certain now that they had winded the tiger and that the latter could not be far off. Getting my gun noiselessly forward into position, I leant over, and remaining motionless, kept my eyes fixed on the carcase in front of me. Its outline could now be seen with difficulty. It was an exciting moment, as any one knows who has sat up on a dark night and within springing distance, waiting for a tiger to put in an appearance. In order to be able to see the muzzle of my gun more easily when taking aim I had tied a small triangular-shaped piece of white cloth, on to the muzzle about half an inch above the fore-sight. The small white procelain night sight being quite invisible without a moon, this served the purpose fairly well, although I could only just see it when the gun was at my shoulder. It was now 7 p.m. and quite dark. I could hardly see the carcase as it lay at full length along the bare patch of pathway which showed up along the centre of the cart track. Suddenly without any preliminary warning, the kill in front of me, at which I had been steadfastly peering, until my eyes felt like starting out of my head, was blotted out of my view and I knew the tiger had caused the transformation and was now standing between me and it like a huge black shadow. There was a death-like stillness for about three or four seconds and then a loud sniff followed by a crunch and the breaking of sinews and bones as the tiger seized the cow by the neck and pulled and tugged for all he was worth to try and remove it. The stout pins and rope however withstood all his mighty efforts although they were continued for the space of half a minute. In the position he was then in I could not see him clearly enough to risk a shot. Moreover he appeared to be all over the place. I preferred to risk a shot only when he was lying down on all fours feeding on the carcase. Just then a buffalo, which had evidently got scent of the tiger or the dead cow, broke loose from the village and came careering along the road towards the carcase. This was evidently too much for the tiger for all sounds from the 'kill' ceased immediately, and he disappeared as quietly as he had come. The buffalo swerved off the road on seeing the body of the cow and then, breaking past the platform on which I was seated, nearly carrying me and it away with him in his mad rush, disappeared into the jungle with a terrific clatter. I was terribly disappointed, for of course I never expected to see the tiger again. All became still once more and the minutes went past like hours. I was determined to give the tiger two full hours' grace before descending and giving it up as a bad job. But the animal turned up sooner than I expected, within an hour in fact, when the kill received the same violent treatment as on the first occasion. This time, however, having failed in his efforts to remove it, he began feeding on the hind quarters, lying out at full length along the road broadside on to me in the exact position I had hoped to see him occupy. I waited for some seconds which appeared to me like hours, till his suspicions had been thoroughly lulled and his teeth were well home into the meat. Hardly daring to move a muscle for fear of alarming him, yet, raising the end of the gun over the parapet of leaves in front of me and taking a long, careful aim for what I took to be the tiger's shoulder, I pulled the trigger. A succession of short, sharp, angry grunts and roars split the air as the animal, evidently hard hit, dashed headlong over the carcase to fight an imaginary foe. I was unable to see from the cloud of smoke which hung between us and hid everything from view, what the brute was really doing. During the few seconds he roared, snarled, and fought over the body of the cow, it was evident to me from the diabolical sounds emitted that he had been badly wounded. Presently all sounds ceased and then a few feet away beyond the 'kill' in front of me, I heard the rattle of some dry bean pods on some small dead bushes, and then all was quiet. I waited for fully twenty minutes before moving or uttering a sound in case the tiger should be lying up close by. Having meanwhile loaded both chambers of my gun with cartridges filled with slugs, drawing a whistle from my pocket I blew several shrill calls to bring up my men. They were not long in putting in an appearance with two hurricane lanterns. I shouted to them when they were about 80 yards off, to hold hard and not to be in too great a hurry. After we had shouted and yelled ourselves hoarse for a few minutes and conversed with one another at a respectable distance, the men came along the road holding their lanterns high above their heads, whilst I stood and covered their approach with my gun. As they came up I descended from the machan, and with them carefully examined the 'kill' and the surrounding ground for any marks of a bullet-hole. After a lengthy inspection, we failed to find any bullet-hole but we noticed that the tiger, after being hit, in his rage and agony had sprung upon the cow's head and worried it, pulling off a horn with its teeth during the mad struggle which followed my shot. There was only a splash of blood on the carcase of the cow which, according to one of my men, had fallen from the tiger's mouth. 'This is a good sign', another man said, 'he has been shot through the lungs and we will find him in the morning, close by, dead.' I had considerable doubt about this in my own mind at the time. A tiger which has been shot through the heart, liver or lungs, that is to say, which has received a mortal body wound, seldom utters any sound at all, or only emits an almost inaudible grunt as he makes off. But a tiger that has had a shoulder or a leg broken or gets a smack from a bullet on the face or head without the brain being injured, invariably roars or snarls loudly when hit. There was nothing more to be done that evening so I mounted my pony and galloped back to Sinbo where I arrived in time for dinner. On the following morning I was off again to the scene of yesterday's adventure accompanied by three military Police Sepoys, two being Gurkhas and the third a Kachin who expressed a keen desire to accompany me. They were armed with Martini Henry rifles and kukries. Three Burman villagers also begged to be allowed to come. There were seven of us all told including myself, four or five too many perhaps. It was a case of footing it of course. Elephants were not available and no one would undertake to either lend us their buffaloes or drive a herd ahead of us in order to induce the tiger to charge them and enable a shot to be got in before he got home on to some one. We had not followed the blood trail into the jungle many yards—about eighty or so perhaps altogether, when we came upon two pools of blood, and the impression of the tiger's form on the grass where he had evidently lain down and rolled about the night before. Village Police Constable Maung Po, one of the most experienced men of our party, who, like his two confréres was armed with a muzzle-loading Enfield musket, the Gurkhas having their Martini Henry rifles, now turned to me with a look and said in an undertone, 'Sir, I am afraid it is a case of having to shoot again should we come up with him, for he is alive.' I had thought this was coming.

Down to zero sank all my hopes at once of ever seeing the tiger again. However there was no getting out of it now. I decided to push on regardless of all consequences. To cut a long story short, let me say that after taking on the blood spoor for another 150 yards or so and crossing the dry bed of a small nullah a few feet in width, all traces of the wounded animal disappeared Casting carefully round for these, my men scattered slightly to right and left of me in a crescent, with no one anywhere ahead of me. We were then only about 600 yards or so from the village. The spoor led us round in a semicircle inclining back towards the village. The jungle showed signs of becoming denser than any we had as yet passed through. Two men viz., Maung Po, the village Policeman already referred to, and a Gurkha Sepoy, had branched off together to my right; two other men turned off at right angles to my left, whilst the remaining two men, a Kachin Sepoy, and a village constable, who had dropped to the rear a little, some 20 yards behind me, also turned off to the right and began walking up the dry bed of the stream we had just crossed. We were all busily engaged looking ahead and stooping every now and then scanning the ground for the lost blood spoor, and had hardly parted company many seconds when my ears were greeted by a succession of short, grunting, coughing roars from my right, in the direction taken by Maung Po and his companion. The whole affair was over in ten or fifteen seconds. According to Maung Po, the tiger which did not come along at any great pace, made a bee line for the Gurkha, who was standing some three paces from his right, having evidently spotted him from the beginning. He, unfortunately was wearing a pair of white cotton shorts, a fact which, when starting on the trail and in the excitement of the moment, had escaped my notice. Maung Po was more sensibly dressed in nature's garb principally, having nothing on but a dark coloured cotton loin cloth, tucked up in front and behind according to the custom of the country. He jumped to one side, and at a distance of about six paces fired at the tiger's shoulder as it came on at the Gurkha, failing however to stop it. The sepoy, according to his own statement, and that of Maung Po's elicited by me afterwards, fired at the tiger when it was three paces from him, hitting it rather low down in the face below the right eye, the bullet eventually finding a billet in the muscles of the neck, where it mushroomed without doing much harm beyond temporarily stunning the animal which still came on at a trot in a dazed manner. A third or fourth shot was fired in rapid succession, but somewhat wildly by the other two men who had gone up the bed of the nullah some way behind. Neither of these shots had the desired effect however, of disabling or turning the brute. A harmless slug from the muzzle-loading Enfield of one of the constables the man who fired the fourth shot was afterwards found embedded in the muscles of the animal's hind legs. The Gurkha, after firing, apparently lost his head. Instead of clubbing his rifle, or jumping to one side which he could easily have done, or attempting to unsheath his "Kukri", the curved heavy knife that all Gurkhas carry when in the jungle, the unfortunate man stood and thrust his rifle towards the animal holding the weapon with both arms at full length before him. The tiger seized the rifle in its teeth, and after chewing and splintering the woodwork, and scoring the barrel with its teeth, three of which were afterwards found broken in consequence, changed its grip from the rifle to the man's right thigh, the latter going over on to his back, screaming wildly. Maung Po, having witnessed this, rushed back to me yelling for assistance. We met half-way, for as soon as I heard the screams of the unfortunate man I rushed forward as quickly as the circumstances would permit till I came within sight of the tiger and at a distance of about half-a-dozen paces, put in three shots behind the shoulder.

Fortunately there was not much chance of hitting the Gurkha by mistake, as when I appeared on the scene the tiger was standing broadside on to me in an open space affording a clear view and an excellent shot. It had its head down and with closed eyes was silently chewing away at the man's right thigh whilst the Gurkha, whose screams were most unnerving, was engaged with the fingers of both hands clawing away aimlessly at the tiger's face which paid not the slightest attention to his movements but continued its horrible work. I wondered at the time that this action on the part of its victim did not infuriate the animal and make it relinquish its grip to a more vital spot higher up the man's body. Maung Po, whose companionship at this time was most acceptable, stood calmly by with an empty gun whilst I loaded and fired. My first shot did not seem to trouble the tiger at all for he paid not the slightest attention to it. It may have been a miss of course, for I was feeling far from comfortable and the whole situation was not conducive to steady shooting. My second shot hit him hard in a vital spot, for, leaping up several feet into the air, two or three seconds after the report, and snarling like the devil, he turned a complete somersault and fell a few yards away, clear of the prostrate man. Hurriedly ejecting the two empty cases, and loading the right chamber only, I, much to my relief, finished him with a third shot. I was only using a 12-bore ball and shot gun burning 4½ drs. of black powder, with a heavy conical bullet, a weapon hardly powerful enough for an encounter of this description. After reloading both barrels, I threw a few sticks at the body in order to make sure that the animal was really dead, and then seeing that it remained motionless, approached the wounded Gurkha, who sat up and asked for a cigarette, remarking in a broken voice that he was afraid his time had come. I cheered him up at once and told him that he would soon be alright. After removing his shorts, I examined his wounds, which at first sight, though deep and badly lacerated, showed that no vital organs had been perforated. They did not, at the time, appear likely to be fatal. Of course it is well known how quickly and easily the whole system is poisoned by bites or wounds inflicted by any of the *Felidae* and how rapidly a wounded man, even though possessed of a powerful constitution, succumbs to his wounds. Snatching a long, new, white muslin turban, some two or three yards in length, from the head of a Kachin sepoy who was standing close by, I bound up the Gurkha's wounds as quickly as possible, and had him carried into the Sinbo hospital within an hour of the occurrence. The wounds, of which there were about six in all, were situated in the front and upper part of the right thigh, between it and the groin but nearer the groin if anything, and there were also one or two deep punctures and scratches on the lower part of the unfortunate man's back. When the wounded man, before being lifted off the ground, told me he could not lift his right leg off the ground, I guessed at once that it had either been broken or dislocated at the hip. It turned out to be the latter. The femoral artery had also been severed partially as the Assistant Surgeon in charge of the hospital told me after the unfortunate man's death, which occurred the following morning at about 3 a.m., he passing away in an unconscious condition. I asked the Gurkha at the time after the accident occurred why he had not attempted to draw and use his Kukri, which he was wearing, either as a stabbing or a cutting weapon. His reply was, 'Sahib, I knew nothing. I did not know what to do, I lost my head.'

My first bullet fired from the machan had, after hitting the tiger on the top of the neck and missing the spine by a very little, continued its course, shattering the whole of the left shoulder and rendering the leg absolutely useless as the shoulder was a mass of pulp. I forgot to mention that the tiger, according to those who had seen him charging, came out on three legs, with the left leg swinging clear of the ground. No man, however good a sprinter he may be, can expect to escape from a charging tiger, even though the latter has the use of only three legs.

Although a badly wounded tiger should be followed up and killed as soon as possible after being wounded, so that the brute will not maul villagers and become, very possibly, a man-eater, he should be followed up, if possible, by the sportsman, mounted on



1. The record tiger for Burma, 10 ft. 4 in., shot in the Myitkyina District.

2. The record tiger for Burma with the author.

the back of an elephant, or, if these animals are not available, a herd of buffaloes should be collected and driven through the jungle where the animal may be lying up so that he may be induced to charge these and thus give those following him a chance of seeing and shooting him. For a photograph of this tiger see plate I, 1 and 2.

The circumstances under which the third tiger was shot were somewhat peculiar and thrilling.

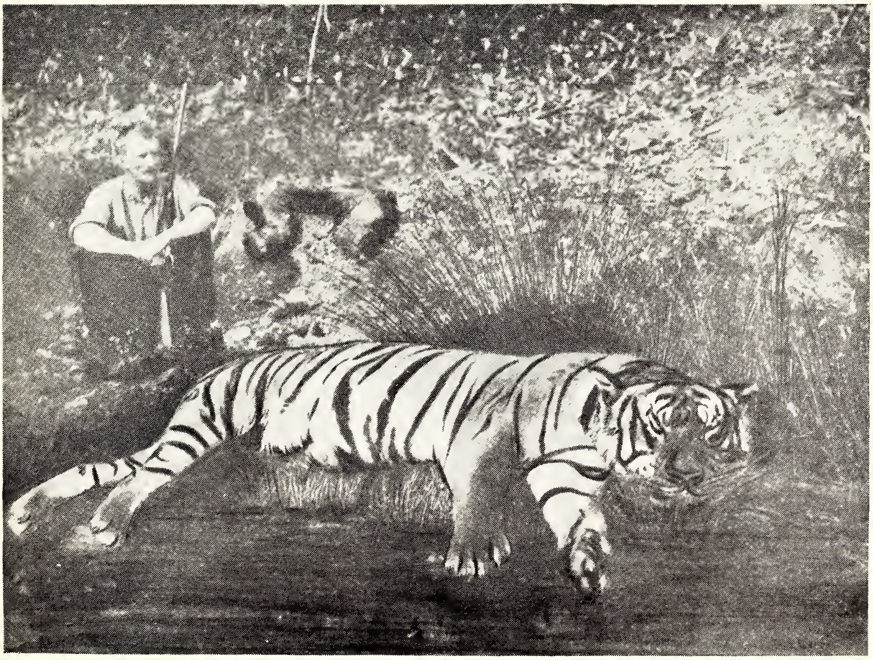
I was out after rhinoceros, bison and elephant along the water shed of the hills which divide Arakan from Thayetmyo. It was in the month of May. We were encamped amongst the Arakan Yoma Mountains at an elevation of about 4,000 ft. A lovelier spot for a station could not be desired. Long undulating stretches of perfectly open grass country rolled away on either side of my camp for a distance of at least two miles and plenty of delightfully cool clear water was to be had within easy reach of the summit from which point a magnificent view of the surrounding country was obtainable. What with the mighty Irrawaddy to the east on one side, lying as it were at my feet some 45 miles away, with its tiny specks of sailing boats and smoking steamers and a pagoda here and there glittering along its banks, and Arakan some 90 to 100 miles to the west on the other side with its broken coast and shimmering sea clearly visible to the naked eye, and studded here and there with islands of all shapes and sizes, it was altogether a glorious scene and one alone well worth the trouble of coming to see. When I threw myself down on the ground and buried my face in the short sweet smelling crisp grass I could almost fancy myself back again amongst the bracken and heather of 'Mine ain countree'.

Next day I saw no less than ten sambar feeding along the tops of the hills in the open and during the day my bag was a very fine bull gaur, a good serow standing as high as a small donkey with 11 inch horns and a very good stag sambar. I found the ·303 with soft-nosed bullets, only the tips being exposed, very effective on serow, sambar, and boar. For elephant, bison, and tsaing, the bullet and powder charge is not heavy enough. About 1-30 p.m. on the following day whilst my hunters and I were marching along rather aimlessly down a stream, Tha Yauk, who was leading with my double 8-bore 'Paradox' suddenly drew up and, stooping, pointed to the fresh tracks of a tiger. Their wet and fresh appearance on the gravel bed of the stream showed that the animal could not be very far ahead of us, and that there was a good chance of our coming up with him provided he did not leave the stream and turn off into the jungle. I immediately changed the solid nickel-coated bullets with which the chambers of my double ·303 Enfield had been loaded, for others loaded with soft-nosed projectiles, and instructed Tha Yauk to remain handy with the double 8-bore 'Paradox' loaded with conical hollow-pointed soft lead bullets. When out shooting, I always made a point of taking out a few 8-bore cartridges loaded with large buck shot and 6 drs. of powder for an emergency of this sort. They had unfortunately been forgotten on this occasion. As a stopper in case of a charge from a wounded tiger at close quarters, there is nothing so effective as large buck shot when delivered from an 8-bore 'Paradox' as the pattern is generally fairly close. I then took the lead down the bed of the stream which was full of rocks and boulders and pools of water here and there. I had only gone perhaps about 150 yards, when I suddenly became aware by sounds which emanated from in front, that some animal was splashing about in a pool ahead of me. Could it be a rhinoceros? I moved quickly forward a few more paces when the head and shoulders of a tiger followed immediately by the rest of its body suddenly appeared within full view round the bend in the rocks directly facing me. The animal which was only some 20 paces off stopped dead on perceiving us. We were all in full view in mid-stream. After raising her head to its utmost, to obtain a better view of us, she took us all in with the steadfast gaze of her fierce yellow eyes for about the space of three seconds and then came towards us snarling like the devil. 'Well,' said I to myself, 'we are in for it now, this is a most unusual procedure for a tiger surprised in this fashion to take.'

But, whether after coming up to within 5 paces of us, she realised that we were not the kind of animals she had been accustomed to meet in the jungles, or whether she had got a whiff of our scent, she suddenly pulled up and sprang sideways up into the air most gracefully to a height of 8 or 10 ft. to give us a wide berth, affording me a lovely broadside shot of which I at once availed myself with the ·303. She made no sound on receiving the shot but galloped off down stream and disappeared amongst the bushes. Tha Yauk then said to me, 'Sir, you have hit her fair and square behind the shoulder and I saw the place distinctly where the bullet hit.' A statement of this description would probably stagger some people without any jungle experience and seem to be a bit too tall to swallow but it is quite true nevertheless and I am not going into further particulars here as to the why and the wherefore of things.

We then decided to call a halt to have some breakfast and a smoke. After a great many cautious manoeuvres and detours during which several trees were climbed Tha Yauk caught sight of her ladyship lying stretched out at full length on her right side. I picked up a stone and threw it at the body to make sure but she never moved. So much for the efficacy of the ·303 with soft-nosed Tweedie bullets. That is the first and the last time I ever used a ·303 on a tiger. The tigress measured 8 ft. 9 in. of which her tail was 2 ft. 4 in. (For a photograph of this tigress being skinned see Pl. II, 1.) We found on examining the pool of water from which she had emerged when we surprised her that it contained two newly-killed red land crabs of 4 and 3 in. in length. One crab was lying out of the water on the bank whilst the other one was still in the pool and had only just been killed. The contents of the animal's stomach showed that she had not had a solid meal for some time and although she was full-grown and in prime condition otherwise, she was distinctly tucked in under the ribs. Tha Yauk, one of the most experienced hunters Burma has

1. Skinning an 8 ft. 9 in. Tigris.



2. Tiger shot on the Ru Stream when feeding on the remains of a young elephant. Note the remains of the elephant in the background.

ever seen, informed me that from his own experience and observations of tigers and leopards in these hills, he firmly believed that all the cat tribe, when hard pushed for food during the hot season, that is to say from April to the end of May, when they were unable to approach and stalk game as easily as at other times, owing to the dry state of the undergrowth, leaves, and twigs, were driven to eat fish, fowl, tortoises, snakes, crabs, and the like, in fact anything that was edible.

A fourth tiger was shot in Arakan under rather peculiar circumstances. I was out after rhinoceros and bison one very hot day in April. Marching well ahead of my men and baggage elephants along the banks of the Ru stream accompanied by a couple of Kami hunters, I caught sight of something red glistening in the sun in mid-stream. It turned out to be the head and neck of a tiger sitting submerged in a pool of water on a rock. The range being about 80 to 90 yards the shot was not an easy one as there was a nasty reflection or shimmer from the water owing to the sun. As it was quite impossible to get any nearer without attracting the tiger's attention I sat down on the ground and risked a shot from where I was. The tiger on the report of the rifle, a single-barelled ·500-bore burning 80 grains of cordite, by Westley Richards, disappeared into the water and sank out of view. Then to my astonishment a tigress with two cubs galloped out of a patch of jungle some 30 yards above the spot where the tiger had been fired at, followed immediately by about 20 elephants, the rear being brought up by a stag Sambar and two does. They were all travelling as fast as they could move in the same direction having evidently been disturbed by my shot. This was certainly one of the strangest processions I have ever witnessed for all 26 animals were in sight at the same time before they disappeared round a bend of the stream into the jungle. I had no time to draw a bead on to the tigress but doubled up to the pool into which the tiger had vanished and retrieved the dead animal from the bottom with much reluctance as bubbles were still reaching the surface of the water. I knew however, that the animal if not killed outright by my shot must have been drowned. I found that my bullet had passed clean through the neck severing the vertebrae. This tiger was a very heavy massive animal measuring 9 ft. 4 in. taken straight across between uprights and had a magnificent coat as well as a very fine ruff round his face. I noticed that his stomach was considerably distended whilst a foul odour emanated from his mouth. It did not take me long to discover that he with the tigress and cubs had been feeding on a baby elephant that they had killed up a neighbouring nullah and off which he had evidently had a big feed previous to his immersion. What astonished me was how it was that two full-grown tigers and two cubs had not succeeded in demolishing the elephant entirely for it was not a large animal. A photograph of the dead tiger and the hind quarters of the baby elephant together with the author seated alongside will be found on Pl. II, 2.

Touching on the subject of sounds uttered by tigers the majority of these are well known and have been commented on by a number of sportsmen. I have heard them all, the cat-like call made by a wounded tiger when on the point of death, a whine, a husky half suppressed kind of grunt, a snarl, a purr, a miaow and the 'tak' referred to by Mr. Peacock in page 171 of his book. I have also heard them roar continuously for no apparent reason whatsoever on getting up from their lairs at dark preparatory to making their nightly perambulations and also when they are on the move in search of food. In fact I am of opinion that they often roar in the exuberance of their own spirits. I have heard them also utter the same roar when leaving their kills near Nanyaseik in the Myitkyina District, and in the Pidaung plains of the same district, as well as in many other places on the tops of the Yoma hills between Arakan and Thayetmyo, in places where human beings were seldom met with and where they had not been much disturbed. Mr. Dunbar Brander says that when tigers roar three or four times in succession they are generally trying to get in touch with a mate. I shouldn't think tigers had much if any difficulty in finding their mates when they wanted to do so at any time, by instinct alone. Either animal as a matter of fact, should they become separated for any reason, ought to be able to find its mate. Birds seem to have no difficulty in doing so. A tiger also when on the prowl moves along through the jungle at a long steady swinging silent walk for hours on end uttering roar after roar just as the spirit moves him. I have on two occasions in the cold weather caught the male and female busily engaged *in coitu* and the row they made could be heard a long way off. On these occasions the animals have terrific scraps and kick up a devil of a noise as does the ordinary household cat. I was fortunate enough on one of these occasions in the Tavoy District to be able to shoot the male, the other animal bolting at once. I have on several occasions doubled after a solitary tiger that was on the move, roaring steadily at intervals, in the hope that I might be able to come up with and shoot the animal before the roars ceased, without however any success. Sometimes it seemed to me that I was no nearer the animal than when I started, as the roars although seeming to be quite close were much further away than I thought.

The vision and hearing of a tiger in my opinion is infinitely superior to his sense of smell which it seems to me is practically negligible and not to be compared with that possessed by a rhinoceros, elephant, bison, or tapir.

One evening about 5 p.m. a tigress passed along a game track on the top of the Yoma hills within about ten paces of where I was seated on a rock smoking a cigarette armed with only a shot gun. My camp was only distant about 250 yards. I had the shock of my life of course, but had sufficient presence of mind to remain absolutely still till she disappeared from view. If however, the wind is right a tiger is quite capable of scenting a human being or indeed any other animal.

I was once seated on a low machan about 10 ft. from the ground in some open fields waiting for a tiger to put in an appearance at his kill or rather the remains of one, viz., half a hind leg of a cow. It had little or no meat left on it and I had brought from a neighbouring nullah, a distance of about 250 yards to a position beside my tree as there were no suitable trees in its vicinity on which to erect a machan. There was a full moon on at the time. The tiger appeared at about 8 p.m. and was taking a bee line through the fields at a quick walk for the nullah where he had last left the cow's leg when I suppose that from a distance of about 50 yards he must have suddenly got a whiff of his kill. He turned at once sharply at right angles, and took a straight line for it without increasing his pace in the slightest. This animal gave me an easy shot as he sauntered up to annex the leg of the cow but I missed him most disgracefully and he turned a back somersault into some neighbouring undergrowth and then started 'titting' most vehemently at intervals.

The tiger in my opinion trusts more to his speed, noiseless tread, hearing, eyesight and strength, than to anything else to capture his quarry. When the ground is wet and it is raining the odour given off by a tiger, and indeed by almost all animals other than human beings, except when the latter are perspiring, is usually stronger then than at other times, and warns most animals and assists them in keeping out of harm's way. I was able after years of experience, to distinguish, especially during the wet weather, by the odour left on the grass, undergrowth, or bushes, what animal had passed as each animal has his own pronounced smell. There is for instance to begin with, no mistaking the odour of all the cat tribe. There is almost no difference between the odour left by a rhinoceros and an elephant. There is little or no difference between that left by a pig, monkey or sambar. A bear left little or no odour at all. The same remarks apply to a tapir.

I saw a tigress that I subsequently bagged stalk and kill a doe sambar during the monsoons simply by making an exceedingly rapid noiseless movement towards the deer on the crouch the whole way until the psychological moment when it literally flung itself upon its quarry with lightning rapidity, fastening its jaws upon the sambar's throat and neck and bringing it to the ground with a crash. There was only one startled bell from the sambar before the end came. One might almost say that the attack was as sudden and as rapid as the swoop of a kestrel hawk upon a pigeon or dove. The wind I also noticed was in favour of the tiger. I was within 15 yards when the sambar was seized and was lucky enough to be able to bag the tiger with one shot through the head with a 500-bore cordite rifle whilst it was still gripping the sambar by the throat. One paw of the tiger was over the neck and back of the sambar whilst the other, the left one, was underneath the neck, when I fired. Had I a cinecamera with me at the time I might have been able to get some good snapshots of the scene. The sambar was kicking spasmodically for some seconds after the tiger was dead.

Tigers have a wholesome respect for bull bison and buffalo and consequently prefer to hamstring them first thus disabling them before delivering the *coup-de-grace* at the throat. I have noticed on several occasions that the hind legs of bullocks had been broken when they have been attacked by a tiger but have not always been able to tell whether this had been done by the force of the tiger's weight on the body of the bullock and the stumbling gait of the latter when the tiger sprang upon and seized it, as fang and claw marks were not always visible on the hind quarters. There is no doubt however, that tigers as well as leopards do not kill animals in a uniform manner. Their favourite method in my opinion, and I have inspected many head of bullocks, buffaloes, mules and ponies that had been killed by tigers, is to kill by seizing the head or throat of nearly every animal other than a buffalo or a bison.

I do not think that the sense of smell of the leopard is any greater than that of the tiger. He is certainly a far more wary animal and is quieter in his movements and more cunning in his approach towards a kill. Under certain conditions both tigers and leopards will visit a kill even though they may get a whiff of their enemy—man, provided they don't see him. In these hard times—hard I mean for the *Felidae*—they are continually meeting the genus *Homo* and his scent so often, that they are getting more accustomed to it, and sometimes accordingly disregard it. This applies more to the unsophisticated tiger or leopard, by which I mean those animals that have never been fired at before. They usually fear nothing and often just come on up to the kill regardless of the scent of a human being. The cunning tiger, i.e., the animal that has been fired at, and hit, or missed many times, often does not come near a kill after he has had his first meal of it, and certainly rarely, if ever, comes up to a kill that has been handled or moved to a more favourable position for the erection of a 'machan'. It really makes no difference to a tiger that has never been shot at in Burma how much the kill has been handled or even removed to a new position. He turns up just the same, but I understand the reverse is more often the case in India. Is this because there are fewer unsophisticated tigers in India than in Burma and that the tigers in India are more harassed than those in Burma?

Some tigers have been shot with a lamp placed over a kill to light it and the tiger up. 90 per cent of tigers and leopards will never go near a kill with a lamp over it. An electric contrivance turned on after a tiger or leopard has arrived at the kill dazzles the animal long enough to enable the sportsman to get in a shot. Tigers and leopards are often dazzled and remain motionless on a road at night and can be approached to within a few yards by a car with its head lights full on. They are generally shot with ease but this form of sport is hardly legitimate.

I personally have never shot either a tiger or a leopard from a car or from a machan with an electric projector or contrivance. I have stated before in this article I do not consider it more unsporting to use an electric contrivance or torch from a machan when shooting at a tiger than if one was shooting at a tiger from a machan by moonlight. In the first case, with a torch, or other electric contrivance, one has a better chance of killing the animal outright, whilst in the second case the animal is more likely to get away wounded when fired at by moonlight.

I am afraid I cannot quite see eye to eye with what Mr. Peacock says on page 170 of his excellent book 'A Game book for Burma and Adjoining Territories' regarding the height he considers 'machans' should be from the ground and the distance the sportsman should be seated on the machan from the kill. Thirty feet he says should be the height of a machan. This it seems to me is overdoing it a little. I never had a machan higher than 15 to 20 ft. at the very most from the ground. The machan from which I sat up alone and shot the tiger in Myitkyina which killed the Gurkha was only situated about 8 ft. from the ground and I suppose about 7 or 8 yards from the kill. In this case I had to be as low as possible to be able to see the kill as well as the tiger, there being no moon whatsoever.

As stated before, if a tiger is going to wind a man on a machan who is smoking a cigarette, he will do so just as easily as if the man did not smoke at all. In other words if he is capable of getting one scent he will get the other also. A sportsman may have the luck to be winded by a tiger and he may not. If the tiger is returning shall we say to his kill along a 100 ft. high ridge which happens not to be very far from the machan, whilst the sportsman's scent happens to be blowing along this ridge from the machan in the direction of the approaching tiger, the latter will in all likelihood get the scent and be suspicious and not turn up at the kill at all. It is all luck. There is no understanding the ways of some tigers. Sportsmen have shot tigers from a pit dug in the ground over and over again. I have had many disappointments sitting up for tigers that have never turned up whilst on other occasions I have also had the most glorious luck. My want of luck on those occasions where tigers ought to have turned up and didn't, was not due to any carelessness on my part or through my not taking proper precautions. But I must confess that on the successful as well on the unsuccessful occasions I invariably smoked cigarettes when in the machan but never allowed the butts to reach the ground. Life would not be worth living, I am afraid, if one were to take all one's pleasures too seriously and make tiger shooting for instance from a machan at night an exact science or a matter of life and death.

It is not perhaps generally known and this may perhaps be the first time it has ever been reported viz., that tigers sometimes roll playfully on any offal, filth, decayed substance or animal droppings they may come across in their wanderings as do dogs, especially in the early morning, after rain has fallen the night before. This was brought to my notice very clearly on one occasion. I was making my way through the jungle on foot alone one morning early with the intention of visiting a clearing where the grass had recently been burnt in the hope that I would find a very large solitary bull tsaing whose tracks I had often come across. *En route* when within about 25 yards of the 'Kwin', (Burmese for clearing) I had to jump a small nullah. Just as I cleared it and had landed on the other side I caught sight of a tiger out in the open clearing rolling about on his back, from side to side, in a most playful manner, with all four legs in the air, exactly as a dog does when he rolls on something really smelly, the more smelly the better. The thud of my feet, as I landed, unfortunately, disturbed him for he sprang up and made off at a terrific pace after uttering a single 'whoof'. I went up to the spot and found that the tiger had been rolling on fresh elephant droppings. My baggage elephants had passed through the clearing the evening before and rain had fallen the same night.

With regard to the subject of maneaters and as to how they begin to get a liking for human flesh I would say that my experience has taught me that it may be due to several causes. Tigers do not necessarily become maneaters because they are unable to pull down game through old age, or failing vision, or bad hearing, although there is no doubt that cases of this sort do occur from time to time, poor vision being as much responsible as anything else. Tigers are more likely to go in for killing human beings when they have been crippled or disabled in some manner, say, through a bullet wound or through a scrap with another tiger, boar, or bison. The principal reason in my opinion however why tigers become maneaters is because the tiger kills a human being in mistake for a four-footed animal. He then finds what an easy matter it is to kill the two-footed animal as compared with the four-footed beast and sticks to the killing of human beings. For instance I know of several cases in Burma where Burman hunters have been carried off by tigers when they have been crawling over the ground to stalk say a sambar, pig, or barking deer. They in turn have been stalked and killed by a tiger which in the first instance mistook them for four-footed animals. Had these tigers however, when stalking these hunters, got a whiff of human scent, in all likelihood, they would have made off at once and not continued the stalk. A tiger unless he is a maneater is more afraid of a human being than he is of anything else in the world. I know also of several cases in Burma where villagers sitting alone in thickets in the jungle with a decoy cock with the object of attracting and snaring jungle fowl have been carried off by prowling tigers. They have mistaken the solitary watchmen with their decoy cocks, for four-footed animals. The difference in the tenderness or flavour of the meat of a human being as compared with that of a four-footed animal has nothing whatsoever to do with it. A maneater in due course if not accounted for pretty soon terrorizes the neighbourhood and becomes an adept at the game. Besides getting very wily and one never can tell where or at what hour he will next turn up and carry of a victim, he becomes bolder and bolder after every kill.

I was fortunate in being able to kill a maneating tiger in the Thayetmyo District of Lower Burma many years ago. He had accounted for several villagers. He used to frequent a certain cart track in the jungle some miles from any village and then walk up to and grab hold of any one that came along. At other times he would be heard of along another cart track some miles away in a different part of the district. When I thought it was the turn of the first cart road to get another visit I began to walk up and down it for several miles alone backwards and forwards between the hours of 4 and 6-30 p.m. I was armed with a double ·500-bore rifle. I had been perambulating along the road for three successive days when on the fourth day he trotted out of the jungle on the road in front of me some 70 to 80 yards away. I stepped behind a tree and waited for him to come up feeling far from happy. On catching sight of me in the distance he gave a couple of low grunts and began to trot towards me slowly down the track. I waited till he got within about five paces and was then fortunately able to brain him with one shot through the right ear making him turn a complete somersault. He was found to be a heavy male 9 ft. long in splendid condition with a beautiful coat.

Tigers are also sometimes driven to killing human beings owing to the scarcity of game and absence of village cattle.

The habit tigers, as well as leopards, have of easing themselves on a bare patch of ground which they have scraped clear is exactly the same as that of an ordinary household cat. There is no difference at all. The operation is sometimes accompanied by a faint 'miaow', whine, or grunt in the case of all three animals. I saw from a machan in which I was seated a tiger relieve himself within a yard or two of his kill in broad daylight in the Myitkyina District. This tiger was shot by me at the same moment through the head, the time being about 4-30 p.m. The animal gets into a peculiar cramped crouching attitude as if about to become paralized in the hind quarters, the two hind feet moving backwards and forwards, the tail twitching at the same time with peculiar spasmodic jerks. I saw and bagged a black leopard which was performing the same operation, in exactly the same manner as a tiger along a jungle path a few yards in front of me before I shot it. I raked him with a soft-nosed ·303 bullet which entered the spine at the root of the tail and broke up in his chest killing him practically on the spot.

In order to see whether there was any difference between the methods of a cat, tiger, and leopard I watched a black cat of mine ease itself on numerous occasions and came to the conclusion that all three animals behaved more or less in a similar manner when easing themselves. There isn't a more cleanly animal in the world, so far as outward appearances are concerned than the household cat. Although its fur is full of millions of germs, it has as perfectly groomed a coat as any leopard or tiger, except that the two last-named have numerous ticks on them which the first-named seldom if ever has. Because of this incessant use of the tongue and saliva upon the coats of all three of these animals they are rarely attacked by any skin disease. You will see many dogs with skin-disease wild as well as tame and also jackals for I have shot wild dogs suffering from skin-disease, but rarely if ever any of the cat tribe owing to this method of cleansing the coat with the tongue and saliva. As a matter of fact any one that handles a cat's fur at all should wash his or her hands at once afterwards before smoking or eating food as there is no knowing what diseases are communicated through handling their fur. I expect the same remarks apply to the fur of the *Felidae* but not to the same extent.

All the *Felidae* will eat putrid meat when they are hungry and they all clean and sharpen their claws on trunks of trees.

A tiger has no cut and dried methods of finding his prey when he is hungry but there is no doubt that he often visits salt-licks at night in the hope of seizing a sambar, bison calf, or perhaps a barking deer. Pigs do not usually visit a salt-lick as they do not eat the saline earth or partake of the waters as do all ruminants. The only animals that visit salt-licks in Burma are the deer tribe, elephant, tapir, rhinoceros and all the bovines such as gaur and tsaing. I have, however, seen jungle fowl, peafowl, imperial, as well as green pigeon, and also the Gibbons sip at the waters of a salt-lick. There is some mysterious fascination about a salt-lick that seems to attract all kinds of animals and birds to it, whether they do or do not partake of the waters or salty-earth there, for I have often found all sorts of birds there including hornbills and heard a regular twittering and chattering going on.

I remember one evening about 6 p.m. in the Myitkyina District visiting a jheel where I was told we might find a good sambar stag towards sunset ·feeding on the young grass growing on the edge of the water. We were walking slowly round the jheel which was only about 200 yards in length by about 150 yards wide when a flock of cotton teal got up with a splash and went off into space with a whirr. Almost immediately after I caught sight of a tiger running up out of the jungle towards the edge of the jheel on the side opposite to that on which I was standing with its head up in an expectant attitude. He was off like a flash however when he caught sight of me and my hunter, and unfortunately, I was unable to draw a bead on him. There was no doubt that this tiger was questing for food and was on the watch at the jheel and knew right well that the teal had been disturbed by some animal which he came out with the intention of bagging.

A tiger seems to wander aimlessly about at night along pathways, forest firelines, the beds of streams, cart tracks or even public high roads for miles at a time. He may or may not be questing for food. It just depends when he last had a meal. Any way he wanders long distances during the night and does not necessarily return the same night but lies up in the thickest, coolest, and darkest place he can find where he is not likely to be molested till dark when his peregrinations begin again. Should he come upon anything to kill on these occasions he does so and has a meal, but he does not seem to me to put himself about a great deal to obtain it. It is only when he finds game is scarce and gets very hungry that he begins stalking and killing village cattle. A tiger it seems to me can carry on for at least a week if not more without having a meal. Tigers do not like the damp at all and they invariably move into the hills if there are any in the vicinity in preference to living in flat country when the rains are on. In Burma, at any rate, tigers that come down from hilly country to kill cattle or find game, invariably go back into the hills towards the beginning or middle of July. This applies to bison as well.

Tigers seem to be extremely fond of pork for they will follow a sounder of pigs for days together and make several kills one after the other, and there is no doubt that the tiger that once starts killing pigs will stick to pork as long as he can, even though it should be village pork. A tiger, as indeed a leopard, rarely bounds or gallops after any animal he has missed in his first spring. If he does not succeed in seizing his prey in the first two or three bounds he usually relinquishes it. He loves a bath as much as any other animal when the weather is warm and his stomach is full of meat and is often found immersed in a stream up to his neck. As is well known he is a powerful swimmer. I was once coming down the Lemro River in Arakan in a dug out spinning for mahsir with a spoon about 10 a.m. one morning when I was suddenly startled by hearing something rise out of a pool of water amongst some rocks to my right some ten to fifteen paces off. Presently a tiger rose out of the water and trotted slowly up the bank out of sight into the jungle before I could pick up and use a ·355 Manlicher rifle that I had in the boat at the time. We were going down rather a rapid run at the time and the dug out was wobbling about a bit, whilst I was expecting to get into a good Mahsir at any moment. The rapid and the pool at the end of it was a particularly famous one for big fish I having caught in it not many days before, a 48½ pounder.

I once came face to face to within about 4 yards of a tiger. I was hurrying along back to camp at dusk with only a walking stick in my hands as camp was within 300 yards. All the animal did was to give a snarl and a 'whoof' as he sprang back off the track into the jungle where I heard him bounding away through the undergrowth for the first 25 or 30 yards when all sounds ceased. There might have been a very different story to tell had it been a tigress with cubs.

With regard to the colouration of tigers and leopards I have shot tigers in heavy ever-green jungle as well as in scrubby light jungle and I do not think there was much if any difference in the coats or colouration of the animals. There is no doubt however that the hill leopard that inhabits dense ever-green clad hills and forests usually possesses a magnificent dark coat with very fine dark-coloured clearly defined rosettes as compared with his brother of the plains. A tiger or leopard shot in any place where frost or a good cold weather is experienced usually possesses a better coat from December to the middle of February than during the rest of the year. I have also noticed that tigers which inhabit very steep hilly country are not as a rule as large as those animals found in low-lying dense ever-green tree forests.

THE FLORA OF WAZIRISTAN.

BY

THE LATE E. BLATTER, S.J., Ph.D., F.L.S. and J. FERNANDEZ.

PART V.

(*Continued from page 424 of this volume*).

ROSACEAE[1]

2,000 species.—Cosmopolitan.

PRUNUS (Tourn.) L.

85 species.—N. temperate; a few tropical.

Prunus communis Hudson Fl. Angl. ed. 2, i, 212.
Vernacular name: Plum, Prune, Sloe, Damson; Alicha (Waziri).
Locality: *N.W.*: Boya, 4,000 ft., cultivated (F. 898 !).
S.W.: Wana, 4,500 ft., cultivated (F. 3580 ! 3612 ! 3663 ! 3665 ! 3670 ! 3671 !).
Distribution: Indigenous in Europe and W. Asia. Cultivated in Baluchistan, Afghanistan, Punjab, and the N.-W. Himalaya.

Prunus leucophylla Blatter in Journ. Ind. Bot. Soc. ix (1930) 206.
Vernacular name: Mamumiae (Waziri).
Locality: *N.W.*: Boya, on hills, 4,000 ft. (F. 424 ! 425 !).—Razani, 5,000 ft. (F. 2751 !).
Young fruit in April.
Uses: Fruit eaten.

Prunus eburnea Aitch. in Journ. Linn. Soc. xviii (1880) 50.
Locality: *N.W.*: Shakai, 6,000-7,000 ft. (Duthie's Collect. 15625 !).
Flowers: 19-5-1895 (Shakai).
Distribution: Afghanistan, Persia.

Prunus Padus L. Sp. Pl. 473; Stewart Punj. Pl. (1869) Rosac. 83; Aitchis. Fl. Kuram Valley (1880) 51; Brandis Ind. Trees (1911) 280.—*P. cornuta* Wall. Cat. (1828) no. 716; Parker For. Fl. Punj. (1918) 205.
Vernacular name: Bird Cherry.
Locality: *S.W.*: Pre Ghal (Hay !, J. Williams 7806 !).
Distribution: Kuram Valley, Trans-Indus, Himalaya, Hazara to Sikkim, 4,000-10,000 ft. (Brandis).

Prunus Amygdalus Stokes Bot. Mat. Med. iii, 101.
Vernacular name: The Almond tree; Badam (Waziri).
Locality: *S.W.*: Wana, 4,500 ft., cultivated (F. 3587 ! 3659 !).—Near Razmak (Stewart).
Distribution: Indigenous in W. Asia and the Kuram Valley. Cultivated in the Mediterranean region, Persia, Afghanistan, Baluchistan, Punjab, Kashmir.

Prunus persica Stokes Bot. Mat. Med. iii (1812) 100.
Vernacular name: The Peach; Shavtalai, Shevtali, Perai kalkundie (Waziri).
Locality: *N.W.*: Boya, 4,000 ft. (F. 896 ! 1365 ! 1376 ! 1377 !).—Miram Shah, 3,000 ft., cultivated (F. 1073 ! 1088 ! 1090 !).—Razani, 5,000 ft. (F. 2102 ! 2103 ! 2106 ! 2107 ! 2108 ! 2109 ! 2759 ! 2825 ! 2840 ! 2884 !).

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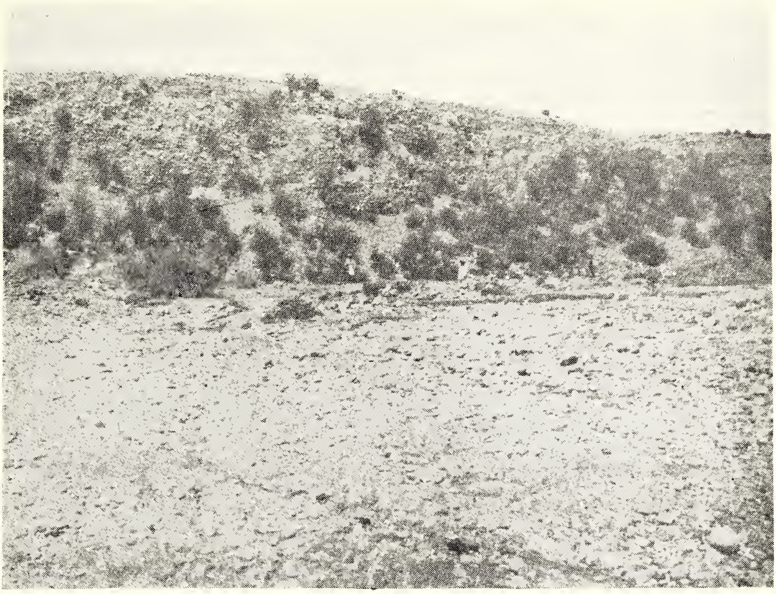
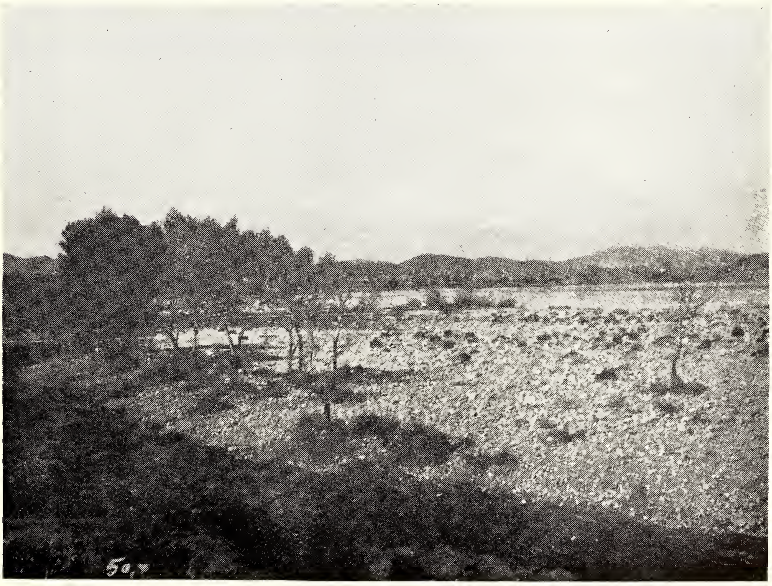
[1] This order should be inserted after the *Leguminosae*.

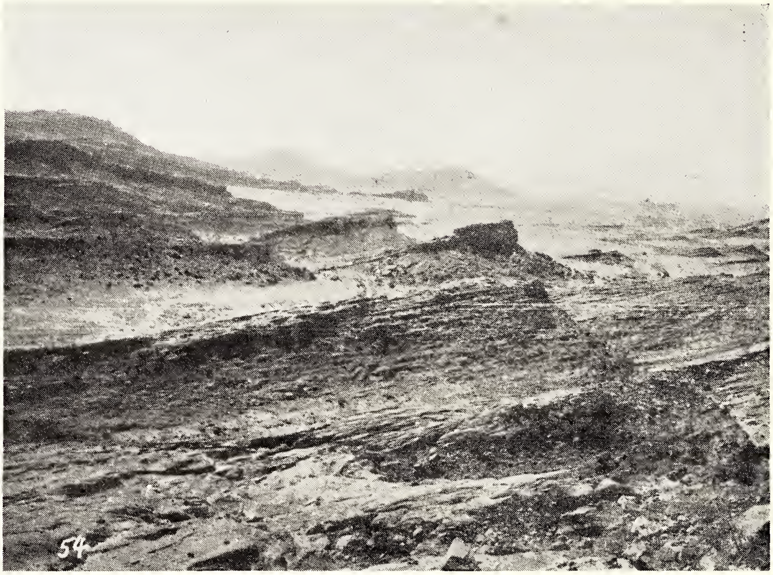


18. *Capparis decidua* Edgew. on precipitous left bank of Volam River near Shewa Post.

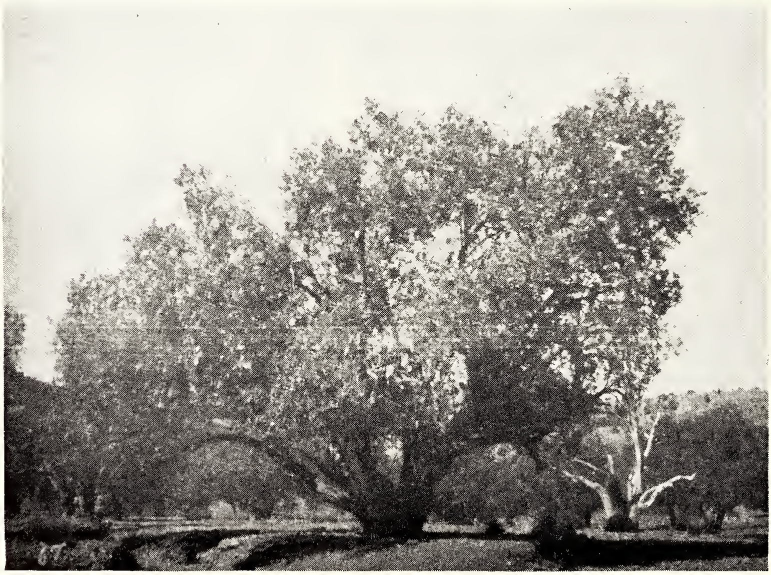


19. From bank of Kuram River up the river due North. In bed *Tamarix*. In the middle distance Shewa Village with Mulberry trees.

Photos by J. Fernandez.



20. Out-crops in a vast plain W. of Spinwam Fort.



21. River bed of Khunai. Old *Olea cuspidata* Wall. with *Viscum album* L.
Photos by J. Fernandez.

S.W.: Wana, 4,500 ft., cultivated (F. 3633 ! 3666 ! 3668 !).—Above Anai Gorge (Stewart).—Kaniguram, about 6,500 ft. (Stewart).—Between Makin and Razmak (Stewart).

Flowers: March.

Unripe fruit in June.

Distribution: Probably a native of China. Cultivated in N. India, in the Himalaya up to 10,000 ft., Baluchistan, W. Asia, Europe.

Prunus armeniaca L. Sp. Pl. i (1753) 474.

Vernacular name: Apricot; Mandata (Waziri).

Locality: *N.W.*: Miram Shah, 3,000 ft. (F. 1072 ! 1075 ! 1082 ! 1083 !).—Boya, 4,000 ft., cultivated (F. 1344 ! 1345 ! 1346 ! 1368 ! 1369 !).—Razani, 5,000 ft. (F. 2166 ! 2187 ! 2196 ! 2752 ! 2753 !).

S.W.: Wana, 4,500 ft., cultivated (F. 3604 ! 3613 ! 3669 !).—Near Kaniguram, at 6,500 and 8,200 ft. (Stewart).

Young fruit in April.

Fruit: June.

Distribution: Perhaps indigenous in the Caucasus. Bailey thinks it is indigenous in Siberia (Dahuria, Manchuria) to China. Commonly cultivated in Europe, W. and Central Asia, Baluchistan, N.-W. Himalaya, Tibet to 12,000 ft. and in the plains of Punjab.

Spiraea L.

50 species.—N. temperate regions.

Spiraea sorbifolia L. Sp. Pl. 490; Brandis Ind. Trees (1911) 283.—*S. Lindleyana* Wall. Cat. (1828) no. 703; Stewart Punj. Pl. (1869) 88; Parker For. Fl. Punj. (1918) 212.

Vernacular name: Balanza (Waziri).

Locality: *N.W.*: Razani, on stony slopes, 5,000 ft. (F. 2766 ! 2783 ! 2841 ! 2842 ! 2845 ! 2859 ! 2869 ! 2871 ! 2887 ! 2889 ! 2891 ! 2905 ! 2908 !).—Razmak, growing on lower slopes, 6,500 ft. (F. 1626 ! 1632 !).

S.W.: Near Kaniguram, about 6,500 ft. (Stewart), also at 8,200 ft. (Stewart).

Fruit of previous year found in April.

Distribution: Punjab, N.-W. Himalaya, 5,000-11,000 ft., Trans-Indus.

Spiraea brahuica Boiss. Fl. Or. ii (1872) 690.

Locality: *S.W.*: Pre Ghal (Duthie's Collect. 15799 !).

Flowers: 15-5-1895 (Pre Ghal).

Distribution: Baluchistan.

Rubus (Tourn.) L.

225 species.—Cosmopolitan, especially N. temperate regions.

Rubus fruticosus L. Sp. Pl. (1753) 493; Aitchis. Fl. Kuram Valley (1880) 52; Brandis Ind. Trees (1911) 286; Parker For. Fl. Punj. (1918) 209.

Vernacular name: European Blackberry; Spangar (Waziri).

Locality: *N.W.*: Datta Khel, near village, 4,500 ft. (F. 1302 !).

S.W.: Above Anai Gorge, about 4,000 ft., hanging in masses from the cliffs (Stewart).—Kaniguram, about 8,200 ft. (Stewart).

Flowers: May 1860.

Distribution: Europe, N. and W. Asia, Afghanistan, Kuram Valley, Hazara, Kashmir, Salt Range.

Rubus gracilis Roxb. Hort. Beng. (1814) 39.—*R. niveus* Wall. Cat. (1828) no. 734; Aitchis. Fl. Kuram Valley (1880) 52 (var.); Parker For. Fl. Punj. (1918) 210.

Vernacular name: Spangair (Waziri).

Locality: *N.W.*: Razani, near stream, 5,000 ft. (F. 2977 ! 2978 !).

S.W.: Razmak, 6,500 ft. (F. 1766 ! 1771 !).

Distribution: Kuram Valley, Trans-Indus, Outer Himalaya from Kashmir to Bhutan, 6,000-12,000 ft., Manipur.

Rubus sp.

Locality: *N.W.*: Boya, on stony ground, 4,000 ft. (F. 1353 !).

FRAGARIA (Tourn.) L.

46 species.—N. hemisphere, Chili.

Fragaria indica Andr. Bot. Rep. t. 479; Stewart Punj. Pl. (1869) 80; Aitchis. Fl. Kuram Valley (1880) 52.
Locality: *S.W.*: Barrarra Pass (Stewart).
Distribution: Afghanistan, Kuram Valley, temperate and subtropical Himalaya from the Punjab to Assam, Khasia Hills, Malay Islands, Japan, Corea, Formosa.

Fragaria visca L. Sp. Pl. 494; Stewart Punj. Pl. (1869) 80; Aitchis. Fl. Kuram Valley (1880) 52.
Locality: *N.W.*: Razani, 5,000 ft. (F. 2953 !).—Miram Shah, planted (B. & F. 644 !).
S.W.: Near Kaniguram brook (Stewart); Razmak, 6,500 ft. (F. 1643 ! 1657 ! 1683 ! 1688 ! 1692 ! 1701 ! 1706 ! 1733 ! 1751 ! 1878 ! 1879 ! 1880 ! 2231 ! 2506 ! 3114 ! 3117 !).—Shuidar Peak near Razmak, 10,980 ft. (F. 2506 !).—Pre Ghal (Duthie's Collect. 15612 !).
Flowers: May, 26-5-1895 (Pre Ghal).
Distribution: Europe, Canaries, N. Africa, Afghanistan, Kuram Valley, temperate Himalaya, N. temperate zone, Java.

POTENTILLA L.

300 species.—Nearly cosmopolitan, chiefly N. temperate and arctic regions.

Potentilla fragarioides L. Sp. Pl. (1753) 496; Boiss. Fl. Or. Suppl. (1880) 234; Burkill Fl. Pl. Baluch. (1909) 30; Fedtschenko & Fedtschenko Consp. Fl. Turkest. pt. 3 (1909) 34.
Vernacular name: Serai (Waziri).
Locality: *N.W.*: Shakai, 6,000-7,000 ft. (Duthie's Collect. 15698 !).
S.W.: Razmak, 6,500 ft., common (F. 2030 ! 2270 ! 2295 ! 3074 ! 3268 ! 3276 ! 3282 !).
Flowers: 30-4-1895 (Shakai); May.
Distribution: Kuram Valley, Baluchistan, temperate Himalaya, Turkestan, E. Russia, Siberia, China, Japan.

Potentilla sericea L. Sp. Pl. (1753) 495; Boiss. Fl. Or. ii (1872) 709; Aitchis. Fl. Kuram Valley (1880) 53; Hook. f. in Fl. Brit. Ind. ii (1878) 354 (*excl. syn. P. soongarica* Bunge); Fedtschenko & Fedtschenko Consp. Fl. Turkest. pt. 3 (1909) 16; T. Wolf Monogr. Gattg. Potentilla p. 161, no. 58, in Luerssen Biblioth. Bot.
Locality: *S.W.*: Razmak, 6,500 ft. (F. 1907 ! 1914 !).
Flowers: May.
Distribution: Caucasus, Afghanistan, Kuram Valley, W. alpine Himalaya from Kashmir to Kumaon, Soongaria, N. China, N. America.

Potentilla reptans L. Sp. Pl. (1753) 499; Boiss. Fl. Or. ii (1872) 723; Aitchis. Fl. Kuram Valley (1880) 53; Fedtschenko & Fedtschenko Consp. Fl. Turkest. pt. 3 (1909) 35; Blatter Fl. Arab. pt. 2 (1921) 190.
Locality: *S.W.*: Razmak, 6,500 ft. (F. 3188 ! 3198 !).—Kaniguram (Duthie's Collect. 15751 !).
Tank: Near Tank.
Flowers: 14-5-1895 (Kaniguram).
Distribution: Europe, N. Africa, Abyssinia, Persia, Turkestan, Afghanistan, Kuram Valley, Siberia, N. China, Japan.

Potentilla supina L. Sp. Pl. (1753) 497; Boiss. Fl. Or. ii (1872) 725; Aitchis. Fl. Kuram Valley (1880) 53; Burkill Fl. Pl. Baluch. (1909) 30; Fedtschenko & Fedtschenko Consp. Fl. Turkest. pt. 3 (1909) 25.
Vernacular name: Yezhei (Waziri).
Locality: *N.W.*: Razmak, 6,500 ft. (F. 1583 ! 1584 ! 1600 ! 1621 ! 1647 ! 1667 ! 2336 !).
S.W.: Zam (J. Williams 7810 !).
Tank: Near Tank (J. Williams 7809 !).

Flowers: May (Razmak); June (Zam); August (Tank).
Distribution: Cape, tropical Africa, N. Africa, Central and S. Europe, Arabia, Mesopotamia, Turkestan, Afghanistan, Baluchistan, warmer parts of India.

Potentilla sp.
Locality: *N.W.*: Boya, along Tochi River, 4,000 ft. (F. 535 !).
Flowers: April.

POTERIUM L.

1 species.—Italy, E. Mediterranean.

Poterium sanguisorba L. Sp. Pl. 994; Boiss. Fl. Or. ii (1872) 733; Aitchis. Fl. Kuram Valley (1880) 54; Aitchis. Bot. Afgh. Del. Com. (1888) 62.
Locality: *S.W.*: 8 miles below Kaniguram village (Stewart).
Distribution: Europe, Caucasus, Persia, Afghanistan, Punjab, N. Asia.

SANGUISORBA Rupp. ex L.

30 species.—N. temperate regions.

Sanguisorba sp.
Locality: *S.W.*: In the upper regions (Stewart).

ROSA Tourn. ex L.

150 species.—N. temperate and on tropical mountains.

Rosa Beggeriana Schrenk in Fisch. & Mey. Enum. (1a) pl. nov. (1841) 73; Fedtschenko & Fedtschenko Consp. Fl. Turkest. pt. 3 (1909) 38.—*R. Silverhjelmi* Schrenk in Bull. Ac. St. Petersb. ii (1844) 195.—*R. Lehmanniana* Bunge Reliq. Lehm. no. 468 in Mém. Sav. Etr. Petersb. xii (1851) 287.—*R. anserinaefolia* Boiss. Diagn. ser. i, 6, 51, Fl. Or. ii (1782) 677; Aitchis Bot. Afgh. Del. Com. (1888) 63; Burkill Fl. Pl. Baluch. (1909) 30; Brandis Ind. Trees (1911) 287.
Locality: Waziristan, 5,000 ft. (Stewart ex Hook. f.).
Distribution: Persia, Turkestan, Afghanistan, Baluchistan, Kuram Valley.

Rosa Webbiana Wall. Cat. (1828) no. 683; Aitchis. Fl. Kuram Valley (1880) 54; Parker For. Fl. Punj. (1918) 218; Fedtschenko & Fedtschenko Consp. Fl. Turkest. pt. 3 (1909) 38.—*R. maracandica* Bunge Reliq. Lehm. no. 467.—*R. elasmacantha* Trautv. Ind. Sem. Hort. Petrop. (1868) 25.
Vernacular name: Perai sakharzie (Waziri).
Locality: *S.W.*: Razmak, 6,500 ft. (F. 2793 ! 2814 !).—Pre Ghal (Duthie's Collect. 15611 !).
Flowers: 16-5-1895 (Pre Ghal).
Distribution: Turkestan, Kuram Valley, Baluchistan, Inner and N.-W. Himalaya up to 13,500 ft.

Rosa sp.
Locality: *S.W.*: Jandola, 2,200 ft., cultivated (F. 1527 !).

NEURADA L.

1 species.—Mediterranean to Indian desert.

Neurada procumbens L. Sp. Pl. (1753) 441.
Locality: *Tank*: Near Tank (Stewart).
Flowers: April 1860 (Tank).
Distribution: Sind, Baluchistan, Rajputana Desert, Punjab, Afghanistan, Persia, Arabia.

CYDONIA Tourn. ex Mill.

5 species.—Europe, N. Asia.

Cydonia oblonga Mill. Gard. Dict. ed. 8 (1768) no. 1; C. K. Schneider Handb. Laubholzk. 654; Fedtschenko & Fedtschenko Consp. Fl. Turkest. pt. i (1909) 46.—*C. cydonia* Pers. Syn. ii (1807) 40.—*C. vulgaris* Pers. Syn. ii *in corrigend.;* Boiss. Fl. Or. ii (1872) 656; Brandis Ind. Trees (1911) 289; Parker For. Fl. Punj. (1918) 220.

Vernacular name: The Quince; Behi (Waziri).
Locality: *N.W.*: Miram Shah, cultivated, 3,000 ft. (F. 1084 ! 1093 !).
Young fruit: April.
Distribution: Probably wild in Persia and Turkestan. Cultivated in S. Europe and in N.-W. India. 'Rarely if ever self-sown.'—Parker.

PYRUS (Tourn.) L.

65 species.—N. temperate regions.

Pyrus communis L. Sp. Pl. (1753) 479.
Vernacular name: The Pear; Amrith (Waziri).
Locality: *N.W.*: Miram Shah, 3,000 ft., cultivated (F. 1071 ! 1074 ! 1077 ! 1087 !).
Distribution: Indigenous in E. and Central Europe and W. Asia, cultivated in the N.-W. Himalaya, also in Baluchistan.

Pyrus malus L. Sp. Pl. (1753) 479.
Vernacular name: The Apple; Manna (Waziri).
Locality: *N.W.*: Miram Shah, 3,000 ft., cultivated (F. 1076 ! 1081 !).—Boya, 4,000 ft. (F. 893 !).
S.W.: Wana, 4,500 ft. (F. 3537 ! 3588 ! 3635 ! 3667 !).—Razmak, 6,500 ft. (F. 2847 !).
Distribution: Native of Europe and W. Asia, perhaps also of the N.-W. Himalaya.

Pyrus parvifolia Blatter in Journ. Ind. Bot. Soc. ix (1930) 207.
Vernacular name: Sherva (Waziri).
Locality: *N.W.*: Razani, 5,000 ft. (F. 2073 ! 2117 ! 2171 ! 2221 ! 2931 !).
S.W.: Razmak, 6,500 ft. (F. 1693 ! 2786 ! 2811 ! 3084 ! 3100 ! 3189 ! 3312 ! 3344 ! 3346 !), Razmak, open stony ground (F. 2689 ! 3345 !).
Flowers: April.
Uses: Fruit eaten.

CRATAEGUS Tourn. ex L.

100 species.—N. temperate regions.

Crataegus sp.
Locality: *S.W.*: About Kaniguram (Stewart).

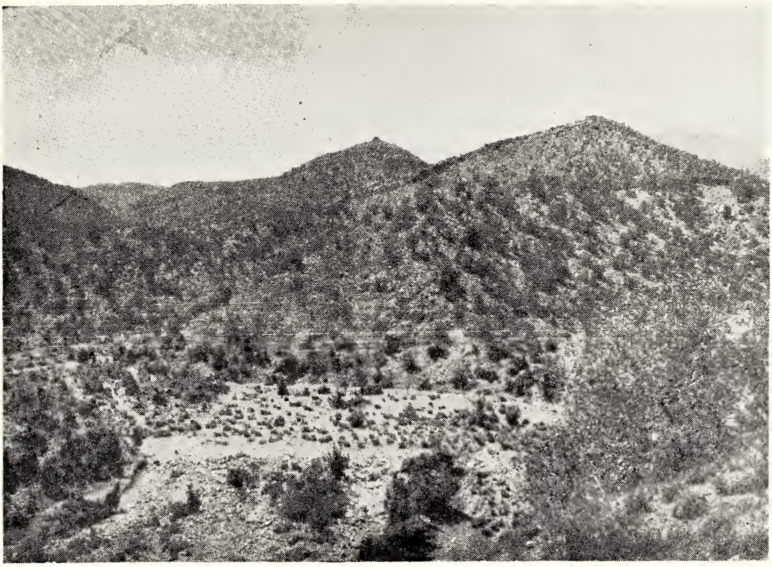
COTONEASTER Rupp.

50 species.—N. temperate regions.

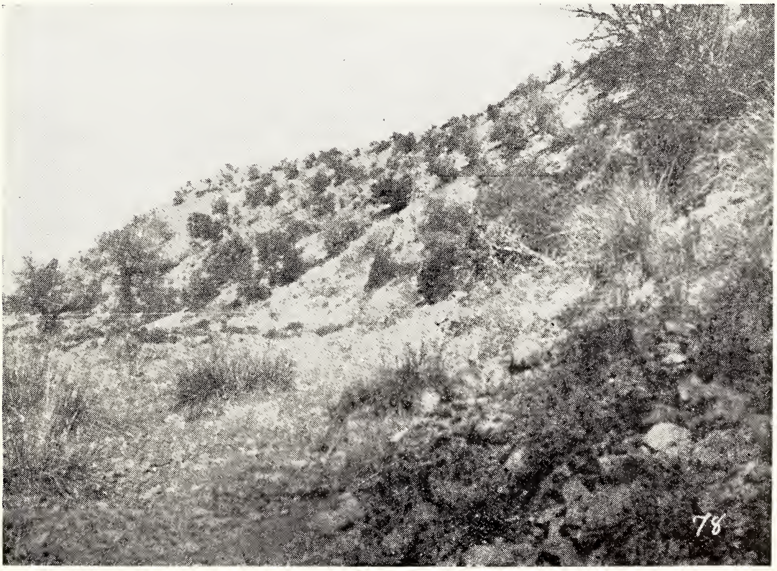
Cotoneaster microphylla Wall. in Lindl. Bot. Reg. (1827) t. 1113, **va buxifolia** Parker For. Fl. Punj. (1918) 228.—*C. rotundifolia* Wall. Cat. no. 663; Stewart Punj. Pl. (1869) 79.—*C. buxifolia* Wall. Cat. no. 661; Hook. f. Fl. Brit. Ind. ii (1878) 387 (*partim*).
Locality: *S.W.*: On a wide shingly plateau at Tandachina (Stewart).
Distribution: Punjab, Garhwal, Kumaon, Sikkim.

Cotoneaster integerrima Med. Ges. d. Bot. (1793) 85, **var.** α ; C. K. Schneider Ill. Handb. d. Laubholzk. 5, Lief. 748; Fedtschenko & Fedtschenko Consp. Fl. Turkest. pt. 3 (1909) 42; Parker For. Fl. Punj. (1918) 227.—*Mespilus Cotoneaster* L. Sp. Pl. (1753) 479 (*partim*).—*M. Cotoneaster* L. *var. rubra* Ehrb. Beitr. iv (1789) 18.—*Cotoneaster vulgaris* Lindl. in Trans. Linn. Soc. xiii (1821) 101; Stewart Punj. Pl. (1869) 80; Aitchis. Fl. Kuram Valley (1880) 56; Burkill Fl. Pl. Baluch. (1909) 32.
Locality: Waziristan (ex Brandis, ex Hook. f., Stewart).
Distribution: Europe, W. Asia, Turkestan, Kuram Valley, Baluchistan, Punjab, Kashmir, Garhwal, W. Tibet.

Cotoneaster racemiflora K. Koch Dendr. i (1869) 170; C. K. Schneider Ill. Laubholzk. fasc. 5, 754; Fedtschenko & Fedtschenko Consp. Fl. Turkest. pt. 3 (1909) 43.—*R. racemiflora* K. Koch. *var. Kotschyi* C. K. Schneider l.c. 754.—*Mespilus racemiflora* Desf. Pl. Hort. Paris ed. iii (1829) 409.—*Cotoneaster Fontanesii* Spach Hist. Veg. ii (1834) 77.—*C. Fontanesii var. songorica* Rgl. Act. Hort. Petrop. ii, 313.—*C. nummularia* Fisch. & Mey. Ind. Sem. Hort.



22. From a hill S. of Razani due S.W. mostly *Quercus* forest with *Olea cuspidata* Wall. In the foreground a nala with tufts of grass, *Olea* and *Sophora*.



23. Bank of Khaisora River with *Olea cuspidata* Wall, *Monotheca buxifolia* Dcne., *Daphne oleoides* Schreb, *Acacia modesta* Wall and clumps of grass.

Photos by J. Fernandez.

Petrop. ii (1835) 31; Aitchis. Fl. Kuram Valley (1880) 56, Bot. Afgh. Del. Com. (1888) 64; Burkill Fl. Pl. Baluch. (1909) 32; Brandis Ind. Trees (1911) 295; Parker For. Fl. Punj. (1918) 228.
Vernacular name: Marmoniae.
Locality: *S.W.*: Near Kaniguram, about 6,500 ft., common (Stewart).—Pre Ghal (J. Williams 7813 !).
Tank (J. Williams 9213 !).
Distribution: W. Asia, Turkestan, Afghanistan, Kuram Valley, Baluchistan, Punjab, Kashmir, Himalaya, 6,000-10,000 ft., W. Tibet.

Cotoneaster bacillaris Wall. in Lindl. Bot. Reg. (1829) ad. t. 1229.
Locality: Waziristan (ex Hook. f. vol. 2, 384).
Distribution: Temperate Himalaya 4,000-8,000 ft., Murree and Kashmir to Nepal, Salt Range 1,500-2,500 ft.

UMBELLIFERAE[1]

2,700 species.—Cosmopolitan, chiefly N. temperate.

VICATIA DC.

3 species.—Himalayas.

Vicatia coniifolia DC. Prod. iv (1830) 243.
Locality: *S.W.*: Pre Ghal (Hay).
Distribution: Himalayan region.

BUPLEURUM (Tourn.) L.

100 species.—Europe, Asia, Africa, N. America.

Bupleurum falcatum L. Sp. Pl. 237.—*B. marginatum* Wall. Cat. 566.
Locality: *S.W.*: Kaniguram (Stewart).—Pre Ghal (Hay).
Distribution: Himalaya, from Kashmir to Bhutan, 3,000-12,000 ft., Khasia Mts., Orient, Central Asia, S. Europe.

CARUM Rupp. ex L.

20 species.—Temperate and subtropical.

Carum Bulbocastanum (L.) G. Koch Umbell. 121, ex Ledeb. Fl. Ross. ii, 249.—*Bunium Bulbocastanum* L. Sp. Pl. (1753) 243.
Locality: Waziristan (Duthie's Collect. 15674).
Distribution: Kashmir 6,000-9,000 ft., Baluchistan, N. Asia, Europe, N. Africa.

HELOSCIADIUM Koch.

Helosciadium nodiflorum (L.) Koch Umb. 26.
Locality: *S.W.*: Wana, stony plain, marsh, 4,500 ft. (F. 3452 !).
Flowers: 16-6-27 (Wana).
Distribution: Central and S. Europe, N. Africa, Abyssinia, Orient.

SCANDIX Tourn. ex L.

12 species.—Europe, Mediterranean.

Scandix pecten Veneris L. var. **brevirostris** Boiss. Fl. Or. ii, 915.
Locality: *N.W.*: Datta Khel village, 4,600 ft. (B. & F. 1490 ! 1506 !).
Flowers & Fruit: 17-4-30.
Distribution of var.: Mediterranean to Baluchistan and Afghanistan.

PRANGOS Lindl.

36 species.—Mediterranean, Central Asia.

Prangos pabularia Lindl. in Quart. Journ. Soc. xix (1825) 7.
Locality: *S.W.*: In the higher regions (Stewart).
Distribution: Himalayan region.

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[1] This order should be inserted after the *Ficoideae*.

PSAMMOGETON Edgew.

4 species.—W. Asia.

Psammogeton biternatum Edgew. in Trans. Linn. Soc. xx, 57.
Locality: *S.W.*: In the lower regions (Stewart).
Waziristan (Duthie's Collect. 15741)
Distribution: N.-W. India up to 3,000 ft., Sind, Baluchistan, Afghanistan, Persia.

DIPSACACEAE[1]

150 species.—Chiefly N. temperate regions, Old World, and tropical and S. Africa.

MORINA Tourn. ex L.

10 species.—E. Europe, Asia.

Morina Coulteriana Royle Ill. 245.
Locality: *S.W.*: Pre Ghal (Duthie's Collect. 15603 !).
Flowers: 17-5-1895 (Pre Ghal).
Distribution: Subalpine Himalaya 9,000-13,000 ft., from Kashmir to Garhwal, Kashgar.

Morina persica L. Sp. Pl. 39.—*M. Wallichiana* Royle Ill. 245, t. 55, fig. 1.
Locality: *S.W.*: Near Kaniguram brook (Stewart).
Distribution: W. Himalaya 7,000-9,000 ft., from Kashmir to Kumaon, Orient (from Persia to Greece).

DIPSACUS L.

12 species.—Mediterranean, Europe, Africa.

Dipsacus inermis Wall. in Roxb. Fl. Ind. ed. Carey & Wall. i, 367.
Locality: *S.W.*: Pre Ghal (Hay).
Distribution: Temperate Himalaya 6,000-12,000 ft., from Kashmir to Bhutan.

SCABIOSA (Tourn.) L.

60 species.—Europe, Mediterranean.

Scabiosa Candolliana Wall. Cat. 430.
Locality: *N.W.*: Shakai, 6,000-7,000 ft. (Duthie's Collect. 15623 !).—Son Khel, 6,000-7,000 ft. (Duthie's Collect. 15760 !).
Flowers: 12-5-1895 (Son Khel); 19-5-1895 (Shakai).
Distribution: W. Himalaya, from Murree to Kumaon, 3,000-5,000 ft., Persian Baluchistan.

Scabiosa Olivieri Coult. Dips. 36, t. 2, fig. 10.
Locality: *Tank*: Near Tank (J. Williams !).—Shaur Hill near Tank (J. Williams !).
Flowers & Fruit: 1-5-1891 (Tank).
Distribution: Baluchistan, Punjab, Afghanistan, Persia, Mesopotamia, Arabia.

SUCCISA Neck.

4 species.—Mediterranean, Europe.

Succisa pratensis Moench. Meth. 489.—*Scabiosa succisa* L. Sp. Pl. 142.
Locality: Near Kaniguram brook (Stewart).
Distribution: Caucasus, Mediterranean, Europe, Siberia.

BORAGINACEAE[2]

1,800 species.—Tropical and temperate regions, especially Mediterranean.

EHRETIA L.

40 species.—Tropical, chiefly Old World.

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[1] This order should be inserted after the *Valerianaceae*.
[2] This order should be inserted after the *Gentianaceae*.

Ehretita aspera Willd. Phyt. 4, t. 2, fig. 1; Roxb. Corom. Pl. t. 55.—*E. laevis* Roxb. *var. aspera* C. B. Clarke in Hook. f. Fl. Brit. Ind. iv, 142.
Locality: *N.W.*: Dwa Warkha (Stewart).
Flowers: May 1860.
Distribution: Punjab, W. Peninsula, Baluchistan, Afghanistan, Abyssinia.

HELIOTROPIUM (Tourn.) L.

220 species.—Tropical and temperate regions.

Heliotropium Eichwaldi Steud. Nom. ed. 2; Boiss. Fl. Or. iv, 131.
Vernacular name: Nil buti (Williams).
Locality: *N.W.*: Dwa Warkha (Stewart).
Tank: (J. Williams 7174 !).
Flowers: 4-5-1888 (Tank).
Distribution: Punjab, Kashmir, Rajputana Desert, Sind, Baluchistan, Orient, Central Asia, Australia.

Heliotropium undulatum Vahl Symb. Bot. i (1790) 13.—*H. ramosissimum* DC. Prod. ix, 536.
Vernacular name: Juthe musag (Williams).
Locality: *N.W.*: Razani (Stewart).
Tank: (J. Williams 7173 ! 7876 !).
Flowers: 9-5-1888 (Tank).
Fruit: 9-5-1888; 6-6-1888 (Tank).
Distribution: Tropical Asia, Orient, Mediterranean.

Heliotropium strigosum Willd. **var. brevifolia** C. B. Clarke in Hook. f. Fl. Brit. Ind. iv, 151.
Locality: *N.W.*: Razani (Stewart).
Tank: (J. Williams 7878 !).
Flowers: 25-6-1888 (Tank).
Distribution: Throughout India, Orient, Malaya, Australia.

Heliotropium cabulicum Bunge in Bull. Soc. Nat. Mosc. xlii (1869) i, 328.
Locality: Waziristan (Duthie's Collect 15800 !).
Distribution: Afghanistan.

HETEROCARYUM A. DC.

Heterocaryum echinophorum (Pallas) Brand in Engler's Pflanzenr. iv, 252 (1931) 95, **var. minimum** (Lehm.) Brand. l.c.—*Echinospermum minimum* Lehm. Pl. Asperifol. (1818) 126, n. 97; Clarke in Hook. f. Fl. Brit. Ind. iv (1883) 162.
Locality: *N.W.*: Near Datta Khel village, 4,600 ft. (B. & F. 1428 !).
Flowers & Fruit: 17-4-30 (Datta Khel).
Distribution: Punjab, Baluchistan, Afghanistan to Asia Minor, S. Russia, Soongaria.

ROCHELIA Reichb.

12 species.—Mediterranean to Australia.

Rochelia disperma (L.) Wettst. in Stapf Bot. Ergeb. Poluk's Reise (1885) 31.—*Lithospermum dispermum* L. Dec. pl. rar. hort. Upsal. t. 7; Sp. Pl. (1762) 191.—*R. stellulata* Rchb. Pl. Crit. ii (1823) t. 122; Rchb. in Flora (1824) 243.—*R. Bungei* Trautv. Contr. ad Fl. Turcom. no. 163, in Acta Hort. Petr. ix, 2, 462.—*R. incana* Kar. et Kir. Enum. pl. alt. no. 605; Ledeb. Fl. Ross. iii, 176; Boiss. Fl. Or. iv, 244.
Locality: Waziristan (Duthie's Collect. 15801 !).
S.W.: About Kaniguram (Stewart).
Flowers: September 1860 (Kaniguram).
Distribution: W. Himalaya, Baluchistan, Afghanistan, Orient, Europe, N. Africa, Soongaria.

ASPERUGO (Tourn.) L.

1 species.—Europe, Asia.

Asperugo procumbens L. Sp. Pl. (1753) 138; Ledeb. Fl. Ross. iii, 165; Boiss. Fl. Or. iv, 201.

Locality: *N.W.*: Dariawasti (B. & F.).
Flowers: April 1930 (Dariawasti).
Distribution: Baluchistan, Afghanistan, Orient, Europe, N. Africa, Siberia, Altai Mts.

*ANCHUSA L.

45 species.—Europe, N. Africa, W. Asia.

***Anchusa italica** Retz. Obs. i, 12.
Vernacular name: Alkanet.
Locality: *S.W.*: Razmak, in garden (B. & F. !).
Distribution: Mediterranean.

LYCOPSIS L.

3 species.—Europe, Asia.

Lycopsis arvensis L. Sp. Pl. 139.
Locality: *N.W.*: Khaisora (Stewart).
Distribution: Europe.

NONNEA Medic.

30 species.—Mediterranean.

Nonnea pulla Lam. *et* DC. Fl. Fr. iii, 626, in note.
Locality: *S.W.*: About Kaniguram (Stewart).

LITHOSPERMUM (Tourn.) L.

50 species.—Temperate regions.

Lithospermum arvense L. Sp. Pl. 132.
Locality: *S.W.*: To Razmak (Stewart).
Distribution: Europe, Orient.

ARNEBIA Forsk.

12 species.—Mediterranean, tropical Africa, Himalaya.

Arnebia Griffithii Boiss. Fl. Or. iv, 213.—*A. echioides* Hook. Bot. Mag. t. 4409.
Locality: Waziristan (Duthie's Collect. 15802 !).
S.W.: Palosina (Stewart).
Distribution: Sind, Punjab, Baluchistan, Afghanistan.

Note.—The flower has a very agreeable odour and a pretty yellow corolla, with 5 dark purple spots on it, which pious Musulmans assert to be the marks of Mahomed's fingers. Hence they call it Paighambari phul (Prophet's flower), and hold it in high favour (Stewart).

Arnebia sp.
Locality: *S.W.*: (Duthie's Collect. 15803 !).

ONOSMA L.

80 species.—Mediterranean, Himalayan.

Onosma echioides L. Sp. Pl. (1753) 196; Boiss. Fl. Or. iv, 181.
Locality: Waziristan (Duthie's Collect. 15804 ! 15805 ! 15806 !).
Distribution: Orient, Europe, Siberia, Altai Mts.

Onosma sp.
Locality: *S.W.*: About Palosina (Stewart).

SCROPHULARIACEAE[1]

2,600 species.—Cosmopolitan.

VERBASCUM Tourn. ex L.

210 species.—N. temperate regions of the Old World.

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[1] This order should be inserted after the *Solanaceae*.

Verbascum Thapsus L. Sp. Pl. 177.
Locality: *N.W.*: Razani (Stewart).
S.W.: Between Makin and Razmak (Stewart).
Flowers: April (Razani).
Distribution: Temperate Himalaya, 6,000-11,000 ft. from Kashmir to Bhutan westwards to the Atlantic.

LINARIA Tourn. ex Mill.

100 species.—N. hemisphere and S. America, chiefly extra-tropical.

Linaria bipartita Willd. Enum. Hort. Berol. (1809) 640.
Locality: *N.W.*: Miram Shah Fort, in garden (B. & F. 524 !).
Flowers: 28-3-30.
Distribution: Egypt, Algeria, Tunisia.

Linaria cabulica Benth. in DC. Prodr. x, 270.
Locality: *N.W.*: Razani (Stewart).
Distribution: Baluchistan, Afghanistan, Persia.

Linaria ramosissima Wall. Pl. As. Rar. ii, 43, t. 153.
Locality: *N.W.*: Shakai, 6,000-7,000 ft. (Duthie's Collect. 15692 !).—Razani (Stewart).
Tank: (J. Williams 7185 !).
Flowers: 30-4-1895 (Shakai); 4-5-1888 (Tank).
Distribution: Throughout India, Sind, Punjab, Baluchistan, Afghanistan, Burma, Ceylon.

SCHWEINFURTHIA A. Br.

3 species.—E. Africa to W. India.

Schweinfurthia sphaerocarpa A. Braun. in Monatsb. Akad. Wiss. Berlin (1866) 875.
Locality: *S.W.*: Jandola (F. 4128 !).
Fruit: 29-5-27 (Jandola).
Distribution: Sind, Baluchistan, Afghanistan.

SCROPHULARIA Tourn. ex L.

120 species.—N. temperate.

Scrophularia calycina Benth. Scroph. Ind. 18.
Locality: *S.W.*: Pre Ghal (Duthie's Collect. 15620 !).
Flowers: 17-5-1895 (Pre Ghal).
Distribution: W. Himalaya, from Kashmir to Kumaon, 6,000-12,000 ft.

Scrophularia scabiosæfolia Benth. in DC. Prod. x, 313.
Locality: Waziristan (Duthie's Collect. 15724 !).
Flowers: 26-4-1895.
Distribution: Punjab, W. Himalaya 10,000-12,000 ft., Afghanistan, Baluchistan.

Scrophularia cabulica Benth. in DC. Prodr. x, 316.
Locality: Waziristan (Duthie's Collect. 15724 !).
S.W.: In the upper regions (Stewart).
Flowers: September 1860.
Distribution: Afghanistan.

Scrophularia lucida L. Sp. Pl. 865.
Locality: *S.W.*: In the upper regions (Stewart; Duthie's Collect. 15646).
Distribution: W. Himalaya, from Kashmir to Kumaon, 8,000-13,000 ft. Afghanistan, westward to Italy.

Scrophularia sp.
Locality: Waziristan (Duthie's Collect. 15619).

HERPESTIS Gaertn. f.

50 species.—Tropical and subtropical, chiefly American.

Herpestis Monniera H.B.K. Nov. Gen. *et* Sp. ii, 366.

Locality: *N.W.*: Razani (Stewart).
Tank (J. Williams 7184 !).
Flowers: 10-5-1888 (Tank); October 1860 (Razani).
Distribution: All warm countries.

WULFENIA Jacq.

3 species.—E. Mediterranean, Himalaya.

Wulfenia amherstiana Benth. Scroph. Ind. 46.
Locality: *N.W.*: Alexandra Ridge, on shaded banks, 7,500-7,700 ft., scarce (Lieut. Abbott 10 !).
Flowers: 1-9-32.
Distribution: W. Himalaya, from Kashmir to Kumaon 7,000-11,000 ft., Afghanistan.

VERONICA (Tourn.) L.

250 species.—Extratropical, many alpine.

Veronica Beccabunga L. Sp. Pl. (1753) 12.
Locality: *S.W.*: Kaniguram (Duthie's Collect. 15744 !).—In a pool on way to the Springs N. of Razmak, 6,750-7,300 ft. (B. & F. 1771 !).
Flowers: 25-4-30 (Razmak); 14-5-1895 (Kaniguram).
Distribution: W. Himalaya 9,000-12,000 ft., Afghanistan to Europe, N. Africa, N. Asia to Japan.

Veronica anagallis L. Sp. Pl. (1753) 12.
Locality: *N.W.*: Upper regions (Stewart).—Shakai, 6,000-7,000 ft. (Duthie's Collect. 15647 !).
Tank (J. Williams 7183 !).
Flowers: 30-4-1895 (Shakai); 17-5-1888 (Tank).
Distribution: N.-W. India up to 15,000 ft., to Bhutan, Bengal, Assam, Deccan, Asia, Europe, N. and S. Africa, N. America.

Veronica Peloponnesiaca Boiss. Fl. Or. iv, 462.
Locality: *N.W.*: Near Datta Khel village, on sand in dry water-course, 4,600 ft. (B. & F. 1451 !).
Flowers & Fruit: 17-4-30 (Datta Khel).
Distribution: Asia Minor.

Veronica biloba L. Mant. ii, 172.
Vernacular name: Babarkiae (Waziri).
Locality: *N.W.*: Along irrigation channel near Datta Khel village, 4,600 ft. (B. & F. 1427 !).
S.W.: 8 miles below Kaniguram valley, abundant in fields (Stewart).
Flowers: 17-4-30 (Datta Khel).
Distribution: W. Himalaya, from Kashmir to Kumaon, 5,000-15,000 ft., westward to Asia Minor, Soongaria.

Veronica agrestis L. Sp. Pl. 13.
Locality: *S. & N.W.* (Stewart).
Distribution: Punjab, W. Himalaya from Kashmir to Kumaon up to 9,000 ft., Orient, Europe, N. and E. Asia to Japan, China, N. Africa.

LEPTORHABDOS Schrenk.

4 species.—Central and S. Asia.

Leptorhabdos Benthamiana Walp. Rep. iii, 387.
Locality: *S.W.*: Pre Ghal (Hay).
Distribution: Temperate W. Himalaya, Kashmir to Kumaon, 5,000-11,000 ft., Afghanistan, Persia.

EUPHRASIA L.

100 species.—Extratropical.

Euphrasia officinalis L. Sp. Pl. 604.
Locality: *S.W.*: Pre Ghal (Hay).

Distribution: Temperate Himalaya, 4,000-13,000 ft., Afghanistan, N. Persia to Europe, N., Central and E. Asia, N. America.

LAGOTIS J. Gaertn.

10 species.—N. and Central Asia.

Lagotis stolonifera Maxim in Bull. Acad. Petersb. xxvii (1881) 525.

See note by O. E. Schulz in Fedde Repert. xxxi (1933) 161-162.
Locality: Waziristan, close to the British Frontier (Hook. f. Fl. Brit. Ind. iv, 558) collected by Stewart.
Distribution: Asia Minor, Armenia to N. Persia.

Lagotis Blatteri O. E. Schulz in Fedde Repert. xxxi (1933) 161, t. cxxxiv.

Vernacular name: Ambreshia (Waziri).
Locality: *S.W.*: Razmak plain, forming dense patches on gravel and sand, 6,750 ft. (B. & F. 47 ! 47b !).
Flowers: 20-3-30.
Distribution: Endemic.

LABIATAE[1]

3,000 species.—Cosmopolitan, chiefly Mediterranean region.

PLECTRANTHUS L'Herit.

110 species.—Palaeotropics, E. Asia.

Plectranthus rugosus Wall. Pl. As. Rar. ii, 17.
Locality: *S.W.*: In the lower regions (Stewart).
Distribution: Himalayan region.

*LAVANDULA Tourn. ex L.

20 species.—Mediterranean to India.

***Lavandula Spica** Cav. Desc. 69.
Vernacular name: Lavender.
Locality: *S.W.*: Razmak, in garden (B. & F. !).
Distribution: Mediterranean region.

MENTHA (Tourn.) L.

25 species.—Old World.

Mentha viridis L. Sp. Pl. ed. ii, 804.—*M. sylvestris* L. *var. viridis* Boiss. Fl. Or. iv, 544.
Locality: Everywhere.
Distribution: Orient, Europe.

Mentha sylvestris L. **var. Royleana** Hook. f. in Fl. Brit. Ind. iv, 647.
Locality: *Tank* (J. Williams 7891 !).
Flowers: 29-5-1888 (Tank).

Mentha sylvestris L., **var. incana** Hook. f. in Fl. Brit. Ind. iv, 647.
Locality: *S.W.*: Near Kaniguram brook (Stewart).
Distribution of type: Temperate W. Himalaya, 4,000-12,000 ft., Afghanistan, Orient, Central Asia, temperate Europe.

LYCOPUS Tourn. ex L.

10 species.—N. temperate regions.

Lycopus europæus L. Sp. Pl. 21.
Locality: *N.W.*: Dwa Warkha (Stewart).
Distribution: W. Himalaya, 1,000-6,000 ft., Orient, Europe, N. and Central Asia.

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[1] This order should be inserted after the *Verbenaceae*.

THYMUS Tourn. ex L.

33 species.—N. Old World.

Thymus syriacus Boiss. Diagn. ser. 1, xii, 47; Fl. Or. iv, 559.—*T. lanceolatus var. angustifolius* Benth. in DC. Prodr. xii, 203.
Locality: *S.W.*: On top of Shuidar, 10,990 ft. (F. 1519 !).
Flowers: 18-4-30 (Shuidar).
Distribution: Syria.

Thymus serpyilum L. Sp. Pl. 590.
Locality: *S.W.*: (Duthie's Collect. 15616 !).—Near Kaniguram, about 6,500 ft. (ex Stewart).—Near Kaniguram brook (ex Stewart).
Distribution: Europe, Asia and N. Africa.

ZIZIPHORA L.

12 species.—Mediterranean, Central Asia.

Ziziphora tenuior L. Sp. Pl. (1753) 31; Ledeb. Fl. Ross. iii, 370.
Vernacular name: Papar boti (Williams).
Locality: Waziristan (Duthie's Collect. 15664 !).
Tank: Shaur Hill (J. Williams !).
Flowers: 21-5-1891 (Tank).
Distribution: Baluchistan, Afghanistan, Orient, Asia Minor, Soongaria, Altai.

PEROVSKIA Karel.

4 species.—W. Asia.

Perovskia atriplicifolia Benth. in DC. Prodr. xii, 261.
Vernacular name: Sansobe.
Locality: *S.W.*: Pre Ghal (J. Williams 7901 !).
Flowers: 24-8-1888 (Pre Ghal).
Distribution: Baluchistan, Afghanistan.

SALVIA (Tourn.) L.

550 species.—Tropical and temperate regions.

Salvia santolinæfolia Boiss. Diagn. ser. 1, v, 13; Fl. Or. iv, 632.
Locality: *S.W.*: Barwand (Duthie's Collect. 15778 !).
Tank (J. Williams 7960 !).
Distribution: Sind, Afghanistan, Persia.

Salvia macrosiphon Boiss. Diagn. ser. 1, v, 11, **var. Kotschyi** Boiss. Fl. Or. iv, 615.
Locality: *N.W.*: Shakai, 6,000-7,000 ft. (Duthie's Collect. 15789 !).
Tank: Near Tank (J. Williams 7908 !).
Flowers: April; August.
Distribution of var.: Baluchistan, Afghanistan, Persia.

Salvia ægyptiaca L. Sp. Pl. (1753) 23.
Vernacular name: Rang boti (J. Williams); Paska (J. Williams).
Locality: *Tank*: Near Tank (J. Williams !).—Shaur Hill, near Tank (J. Williams !).
Flowers: May (Tank).
Distribution: Punjab, Afghanistan, Orient, N. Africa to the Cape Verde Islands.

Salvia lanata Roxb. Fl. Ind. i (1832) 146.
Locality: *N.W.*: Razani (Stewart).
Distribution: W. temperate Himalaya, Kashmir to Kumaon, 5,000-8,000 ft.

Salvia glutinosa L. Sp. Pl. 26.
Locality: *S.W.*: In the higher regions (Stewart).
Distribution: Temperate Himalaya, 6,000-9,000 ft., from Kashmir to Sikkim, Afghanistan, Orient, S. Europe.

Salvia ægyptiaca L. Sp. Pl. (1753) 23, **var. pumila** Hook. f. in Fl. Brit. Ind. 4 (1885) 656.—*S. pumila* Benth. Lab. 726.

Locality: *N.W.*: Dwa Warkha (Stewart).
Flowers: May 1860 (Dwa Warkha).
Distribution: Punjab Plains, W. Peninsula, Sind, Rajputana Desert, Baluchistan, Afghanistan. Type in Orient, N. Africa, Cape Verde Islands.

Salvia macrosiphon Boiss. Diagn. ser. 1, v, 11.
Locality: *S.W.*: Pre Ghal (J. Williams 7894 !).
Distribution: Persia.
Uses: Poultice for gangrene (J. Williams).

NEPETA Riv. ex L.

150 species.—N. hemisphere.

Nepeta spicata Benth. in Wall. Pl. As. Rar. i, 64.
Locality: *S.W.*: Pre Ghal (Hay, J. Williams 7898 !).
Flowers: 17-8-1885; September (Pre Ghal).
Distribution: W. temperate Himalaya, from Kashmir to Kumaon, 6,000-12,000 ft., Afghanistan.

Nepeta raphanorrhiza Benth. Lab. 734.
Locality: Waziristan (J. Williams 9173 !).
S.W.: Near Kaniguram (Stewart).
Distribution: W. temperate Himalaya, 5,000-12,000 ft., Afghanistan.

Nepeta distans Benth. in Hook. Bot. Misc. iii (1833) 378; Lab. 475.—*N. mollis* Benth. Lab. 734.
Locality: *S.W.* (J. Williams 7909 !).
Flowers: 10-8-1888 (S.W.).
Distribution: W. Temperate Himalaya, 8,000-9,000 ft., Punjab Himalaya.

Nepeta juncea Benth. in DC. Prodr. xii, 379; Boiss. Fl. Or. iv, 651.
Locality: *N.W.*: In bed of Khunai River below Razani, 5,050 ft. (B. & F. 1125 !).
S.W.: Barwand, 6,000-7,000 ft. (Duthie's Collect. 15642 !).—Wana, 4,500 ft. (Duthie's Collect. 15670 !).
Flowers: 28-4-1895 (Barwand); 12-4-30 (Razani); 5-5-1895 (Wana).
Distribution: Baluchistan, Afghanistan.

LALLEMANTIA Fisch. & Mey.

4 species.—W. Asia.

Lallemantia Royleana Benth. in DC. Prodr. xii, 404.
Locality: *N.W.*: Razani (Stewart).
S.W.: Kaniguram (Stewart).—Barwand, 4,000 ft. (Duthie's Collect. 15705 ! 15709 !).
Flowers: April 1895 (Barwand).
Distribution: Punjab, Afghanistan, Persia, Turkestan.

SCUTELLARIA Riv. ex L.

200 species.—Cosmopolitan, except S. Africa.

Scutellaria linearis Benth. in Wall. Pl. As. Rar. i, 66.
Locality: *S.W.*: Near Kaniguram, about 6,500 ft. (Stewart), near Kaniguram brook (Stewart).
Flowers: September 1860 (Kaniguram).
Distribution: Temperate W. Himalaya, from Kashmir to Kumaon, 3,000-8,000 ft., Afghanistan.

Scutellaria multicaulis Boiss. Diagn. n. ser. 1, vii, 61; Fl. Or. iv, 685.
Vernacular name: Sandor boti.
Locality: *Tank*: Near Tank, Shaur Hill (J. Williams !).
Flowers: 1-5-9 (Tank).
Distribution: Afghanistan, Persia, Turkestan.

Scutellaria prostrata Benth. Lab. 733.
Locality: *N.W.*: Shakai, 6,000-7,000 ft. (Duthie's Collect. 15652 !).
S.W.: Pre Ghal (Duthie's Collect. 15597 !).

Flowers: 30-4-1895 (Shakai); 19-5-1895 (Pre Ghal).
Distribution: W. Himalaya, from Kashmir to Kumaon, 8,000-14,000 ft.

Scutellaria sp.
Locality: *S.W.*: In the upper regions (Stewart).

STACHYS (Tourn.) L.

200 species.—Cosmopolitan except Australia.

Stachys parviflora Benth. in DC. Prodr. xii, 490.
Locality: *S.W.*: Wana, 4,000-5,000 ft. (Duthie's Collect. 15657 !).—Pre Ghal (J. Williams 7895 !).
Flowers: 5-8-1888 (Pre Ghal); 2-5-1895 (Wana).
Distribution: Punjab, Afghanistan.

Stachys floccosa Benth. Lab. 739.
Locality: *S.W.*: Pre Ghal (J. Williams 7903 !).
Flowers: 17-8-1888 (Pre Ghal).
Distribution: W. temperate Himalaya, 5,000-6,000 ft., Afghanistan.

MARRUBIUM Tourn. ex L.

30 species.—Europe, N. Africa, temperate Asia.

Marrubium vulgare L. Sp. Pl. (1753) 583.
Locality: *N.W.*: Razmak (Stewart).—Shakai, 6,000-7,000 ft. (Duthie's Collect. 15691 !).
S.W.: Wana, 4,500 ft. (Duthie's Collect. 15655 !).—Pre Ghal (J. Williams 7906 !).
Flowers: 30-4-1895 (Shakai); 2-5-1895 (Wana); 1-8-1888 (Pre Ghal).
Distribution: Baluchistan, Orient, Europe, N. and tropical Africa.

MOLUCCELLA L.

2 species.—Mediterranean.

Moluccella otostegioides Prain in. Journ. As. Soc. Beng. lix (1891) ii, 311.
Locality: *S.W.*: Wana, 4,500 ft. (Duthie's Collect. 15788 !).—Shakai, 6,000-7,000 ft. (Duthie's Collect. 15643 !).
Flowers: 30-4-1895 (Shakai); 8-5-1895 (Wana).
Distribution: India.

LEONURUS L.

8 species.—Europe, Asia and tropical regions.

Leonurus sibiricus L. Sp. Pl. 584.
Locality: *S.W.*: Pre Ghal (Hay).
Distribution: Siberia, China.

PHLOMIS L.

70 species.—N. palaeotemperate.

Phlomis Stewartii Hook. f. in Fl. Brit. Ind. iv, 692.
Vernacular name: Chambar-boti (Williams).
Locality: *S.W.*: Wana (Duthie's Collect. 15633 ! 15677 !).
Tank: Near Shaur Hill (J. Williams !).
Flowers: 7-5-1895 (Wana); 21-5-1891 (Tank).
Distribution: Punjab, Salt Range, 2,500-4,500 ft.

Phlomis sp.
Locality: *S.W.*: In the higher regions (Stewart).

EREMOSTACHYS Bunge.

40 species.—Middle and W. Asia.

Eremostachys acanthocalyx Boiss. Diagn. 2, iv, 49.—*E. laciniata* Aitchis. Cat. Punj. Pl. & Scinde 118 (*non* Bunge).

Locality: *N.W.*: Dwa Warkha (Stewart).
S.W.: Above Palosina (Stewart).
Distribution: W. Punjab, Baluchistan, Afghanistan.

TEUCRIUM (Tourn.) L.

100 species.—Cosmopolitan.

Teucrium Stocksianum Boiss. Diagn. ser. 2, iv, 58.
Vernacular name: Kastorai.
Locality: *S.W.*: Wana, 4,500 ft. (Duthie's Collect. 15678 !).—Barwand 4,000 ft. (Duthie's Collect. 15700 !).
Tank: Shaur Hill (J. Williams !).
Flowers: 17-4-1895 (Barwand); 7-5-1895 (Wana); 31-5-1891 (Tank).
Distribution: Baluchistan.

AJUGA L.

30 species.—Palaeotemperate.

Ajuga parviflora Benth. in Wall. Pl. As. Rar. i, 59.
Locality: Near Kaniguram, about 6,500 ft. (Stewart).
Distribution: W. Himalaya, from Kashmir to Kumaon, 2,000-7,000 ft., Afghanistan.

Ajuga bracteosa Wall. Cat. 2032.
Locality: *N.W.*: Shakai (Duthie's Collect. 15649 !).
Flowers: 30-4-1895 (Shakai).
Distribution: W. Himalaya, from Kashmir to Nepal, 1,000-7,000 ft., Afghanistan, Abyssinia, China, Japan.

[Certain Orders have been omitted, but these will appear when they have been worked out by the specialist to whom they have been submitted].

THE INDIAN CADDIS-FLIES (*TRICHOPTERA*)

BY

Martin E. Mosely, F.R.E.S.

Part II.

(*With* 8 *text-figures*).

(*Continued from p.* 664 *of volume* xxxvi).

Classification.

In my last article I dealt with the life-history of the Caddis-flies and the methods to be adopted for their collection and preservation. We have now to consider how to name the insects we may have captured.

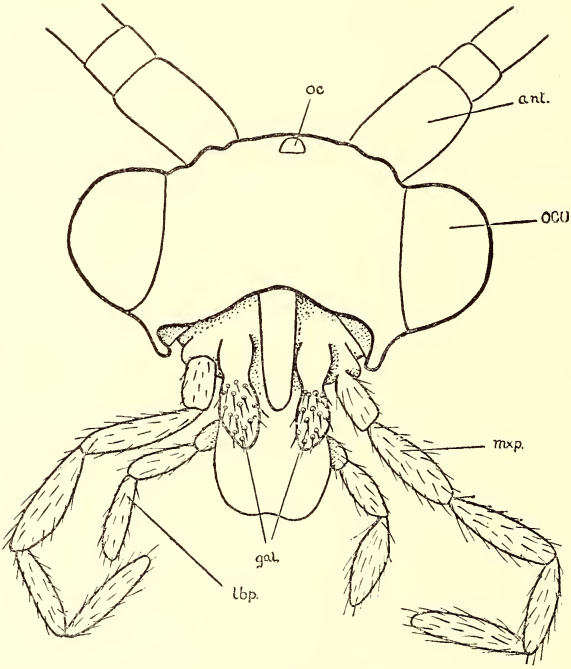

Fig. 1.—Head of *Anabolia laevis* McL.—
oc, ocellus; *ant*, antenna; *ocu*, oculus; *mxp*, maxillary palpus; *gal*, galea; *lbp*, labial palpus.—after Packard.

Before attempting this task, it is necessary that we should have a certain amount of knowledge as to the structures of the head particularly the mouth-parts, the neuration of the wings, the form and construction of the genitalia, etc.

Parts of importance to be recognised in the head are the *ocelli* or simple eyes, three in number when present, the form of the basal joints of the antennae and above all, the structure of the maxillary palpi.

I have already pointed out that one of the main differences between the *Trichoptera* and the *Lepidoptera* is to be found in the form of two processes of the mouth known as the *galea* and that in the latter Order, these processes are enormously produced and form the long sucking proboscis. I will therefore call the attention of my readers to the *galea* (gal.) indicated in figs. 1 and 2 which are diagrammatic representations of the heads of a Trichopteron and a Lepidopteron respectively. Other parts of importance are indicated in the legends accompanying the figures.

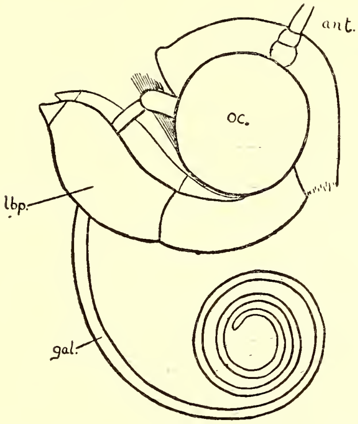

Fig. 2.—Head of a *Lepidopteron*, lettering as in figure 1.

With regard to the wing neuration I am adopting the nomenclature used by Ulmer in the *Genera Insectorum*, based on the Comstock and Needham notation rather than that of McLachlan, as Ulmer's work has a more general application than McLachlan's Monograph of purely European species.

Many of the genera have been erected on characters of neuration so that it is extremely important for the student to make himself thoroughly conversant with the general pattern and the names of the various cells and nervures. They will be referred to again and again and a little time spent in mastering them will be amply repaid when the practical work is taken in hand.

I give here the figure of the wings of a *Hydropsyche* species in which the neuration is practically complete.

The nervure forming the anterior margin of the wing is termed the *costa* (C); beneath this is the *sub-costa* (Sc) which sometimes continues parallel with the *costa* almost for its entire length but generally joins it before the extreme apex of the wing; the *sub-costa* is usually connected to the *costa* by one or more cross-veins, rarely more than two. Arising near the base of the *sub-costa* is a vein which soon forks in two branches; the upper of these branches is the *radius* (R) and the lower, the *radial-sector* (Rs). The *radius* generally flows directly into the *costa;* in *Hydropsyche* and many other genera, the *radial-sector* is forked and each branch of the fork is itself forked thus forming *apical forks* 1 and 2. There is frequently a cross-vein uniting the two branches beyond the first furcation and this encloses a space known as the *discoidal cell* (dc). Below the *radial sector*, proceeding from the base of the wing, we

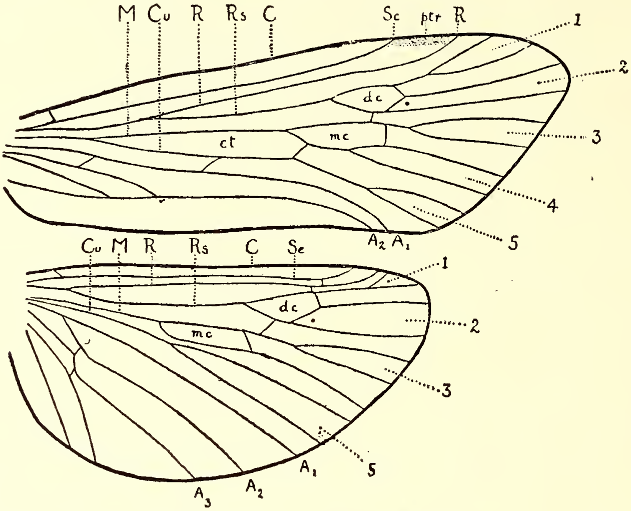

Fig. 3.—Wings of *Hydropsyche* species.—
C, costa; *Sc*, sub-costa; *ptr*, pterostigma; *R*, radius; *Rs*, radial-sector; *dc*, discoidal cell; *M*, media; *mc*, median cell; *Cu*, cubitus; *ct*, cellular thyridii; A_1, A_2, A_3, anal veins; 1, 2, 3, 4 and 5 apical forks.

find another nervure which forks almost immediately to make the *media* (M) the upper, and the *cubitus* (Cu) the lower of the two branches. Following the course of the *media*, we find that it again branches and each branch terminates in a fork, the upper being the *apical fork* 3 and the lower, *apical fork* 4. Here again we find a cross-vein close to the first furcation of the *media* enclosing what is known as the *median cell* (mc); the *media* is generally united to the *radial-sector* by a cross-vein. Tracing the *cubitus*, we find that it forks before meeting the margin of the wing to make *apical fork* 5. In the anterior wing, there is a cross-vein uniting the *media* to the *cubitus* in the region of the *median cell* and this encloses an area known as the *cellular thyridii* (ct). The remaining veins are called *anal veins* (A_1, A_2, A_3) and sometimes *anal vein* 2 is seen to run parallel with the basal margin of the wing when it is known also as the *post-costa.*

In the posterior wing, almost invariably we find the lower fork of the *media* unbranched at the margin of the wing so that fork 4 is wanting. The only known exception to this is found in the genus *Helicopsyche.*

Some allusion will be made to the apical sectors. These are the nervures meeting the apical margin of the wing between the upper nervure of fork 1 (when present) and the lower nervure of fork 5 inclusive.

If we consider the spaces between the nervures, we find, beginning with fork 1, ten cells towards the margin in the anterior and eight in the posterior wing. A dark spot may be observed at the base of fork 2 in each wing. A small area of the membrane at the costal margin between the termination of the sub-costa and the radius is frequently different in texture to the rest of the wing and perhaps darker in colour. This is termed the *pterostigma* (ptr.).

These are the main features that we have to consider. We shall find that in most of the genera some modification of this neuration has taken place and the *apical forks*, which are of extreme importance in the classification, are frequently reduced and sometimes rather hard to recognise, giving cause unfortunately to much theorising amongst various authors.

We have now to consider the abdomen with the all-important structures of the genitalia. In the *Trichoptera* there are nine segments. Dorsally, eight may easily be defined. The first, i.e. the one nearest the thorax, is somewhat in the form of a plate and when the abdomen is detached this plate is seen to have no corresponding ventral segment beneath it. If there is such a segment it is so reduced as to be practically non-existing. We must therefore call the first visible ventral segment No. 2 in order that it may correspond with its dorsal fellow.

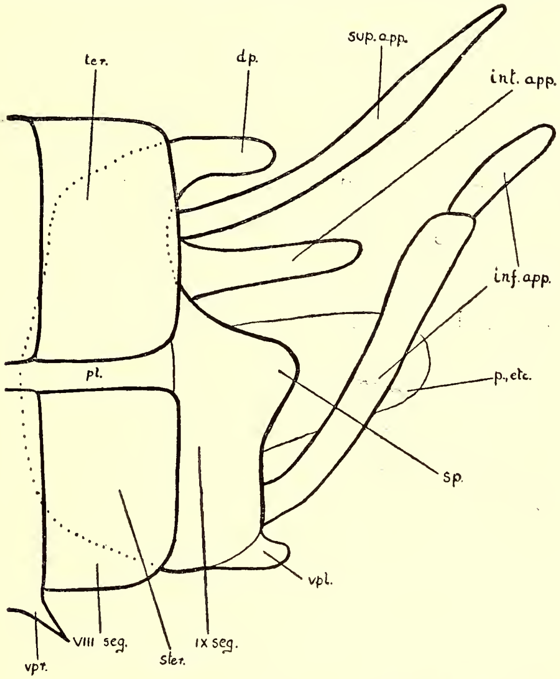

Fig. 4.—Diagrammatic genitalia of a *Trichopteron*.
ter, tergite; *dp*, dorsal plate; *sup. app.*, superior appendage; *int. app.*, intermediate appendage; *inf. app.*, inferior appendage; *p.*, penis; *sp.*, side-piece; *vpl.*, ventral plate; *ster.*, sternite; *pl.*, pleurite; *vpr.*, ventral process.

The second to the eighth segments inclusive are formed of chitinous plates, the dorsal often rather more strongly chitinised than the ventral and generally darker in colour. These plates are joined at the sides, dorsal to ventral, by thin membranes. The dorsal segments are termed *tergites* (ter.), the ventral, *sternites* (ster.), and the thin lateral membranes, *pleurites* (pl.).

The ninth segment is generally partly withdrawn into the eighth and is constructed after a different fashion. Instead of dorsal and ventral plates joined by lateral membranes, we find a strongly chitinised hoop or ring without any lateral divisions. To this segment are attached the parts of the genitalia which, by their variations, give the main characters for the separation of the species.

I give here a diagrammatic figure of the genitalia of an imaginary caddis-fly which is supposed to be equipped with all the parts which compose these structures, a condition which probably does not occur in any individual fly.

Projecting from the centre of the dorsal margin we may have a dorsal plate (dp.) On each side of this and from a little below it there arises a pair of superior appendages (sup. app.), sometimes long and slender, sometimes very short. Below these and still towards the upper half of the segment is a pair of intermediate appendages (int. app.) of varying shape. Then, towards the centre of the segment, we find the penis (p.) with its upper (upc.) and lower (lpc) penis-covers and sheaths (psh), all attached together towards the base of the penis. I am giving a separate outline of these processes in order to avoid confusion in the figure. The lateral margins of the ninth segment are sometimes produced in what are known as side pieces (sp.). Beneath the penis and arising from the lower half of the segment, we nearly always find a pair of inferior appendages (inf. app.), frequently two-jointed. Sometimes the lower margin of the segment is produced at its centre in the same way as the upper, to form a ventral plate (vpl.). There

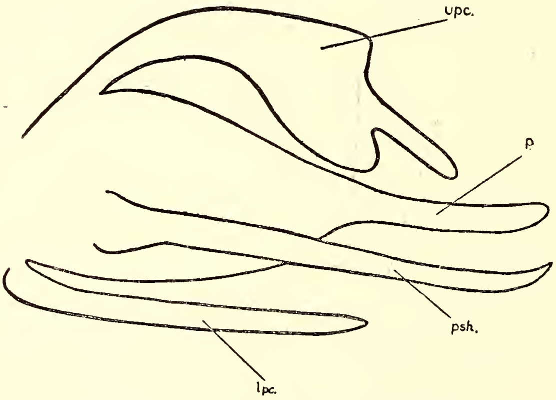

Fig. 5.—Penis and its processes.—
upc, upper penis-cover; *p.*, penis; *psh.*, penis-sheath; *lpc.*, lower penis-cover.

is frequently a spur, sometimes more than one, termed a ventral process (vpr.) arising from the centre of the margin of one or more of the terminal ventral segments.

It generally happens that some of the above parts are missing and it is difficult sometimes to homologise the processes we do find with this diagrammatic conception of a complete genitalia. It follows, therefore, that in describing new species, it is of the utmost importance to give full figures of these parts rather than to depend on a verbal description which may not invariably be interpreted as intended by the author.

Now as to the legs, these are long and slender, often with the tibiae and tarsi of the median legs dilated in the female sex, sometimes in both, and carrying not only numerous short spines but spurs as well though these may be absent in one or other of the legs, never in all three. These spurs are of considerable importance in classification and at one time were considered to furnish good and sufficient characters for the separation of the genera. With a more advanced knowledge of the Order, the importance of the spurs has been somewhat diminished as a generic character so that we may find species with varying spur-formulae placed in the same genus. When we talk of the spurs being let us say 3, 4, 4 or 0, 2, 3, we mean that the anterior leg carries 3 or 0 spurs, the median 4 or 2 and the posterior 4 or 3. As the spurs are apt to meet with accidents and get rubbed off, we must not attach undue importance to their presence or absence. Generally, though, a socket can be made out where a spur has been lost. Spurs are usually longer and paler in colour than the spines.

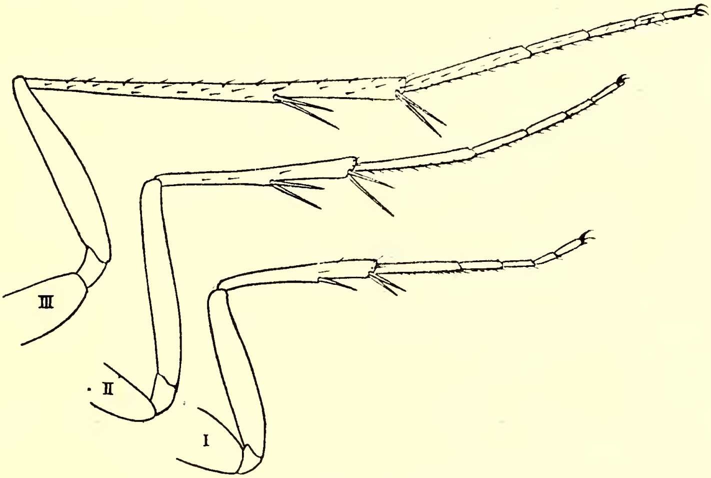

Fig. 6.—Legs of *Rhyacophila* species.—
(1) anterior leg; (2) median leg; (3) posterior leg.

Finally we occasionally find some modification of structure in various parts which may furnish a clue to the identity of a capture. In the head there are sometimes specialised structures such as scent-organs. These may be situated at the back of the head as in *Hydroptila*, or at the base of the antennae as in *Triaenodella* or even in the maxillary palpi as in *Sericostoma* and *Goëra*. Sometimes we find long filaments attached to the fourth ventral segment at the lateral margins as in *Diplectronella* and other genera. Or we may find a fold or a callosity at the base of the anterior wing as occurs in *Glossosoma* and *Beraea*. In *Drusus* and the allied genera, there is a long pencil of hairs situated in a fold towards the base of the posterior wing. Sometimes the wings are clothed with modified scales in addition to hairs (*Dinarthrum* and its allies) and in some species androconia, which are specialised scent-distributing scales, are present on the wings or other parts (*Beraea*, *Pseudostenophylax*, etc.). These modifications are nearly always restricted to the male sex, though lateral filaments occur in both.

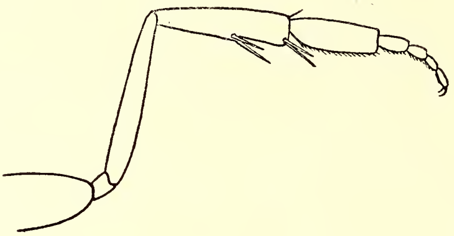

Fig. 7.—Median leg of ♀ *Glossosoma* species.

Every insect captured should be examined with the utmost circumspection and it is astonishing how many curious and interesting characters of this nature will be found amongst the Trichoptera.

We will now consider the subject of Classification. A little history is called for here. Until Pictet published his renowned *Recherches sur l'histoire des Phryganides* in 1834, the condition of this group of insects appears to have been chaotic. The Caddisflies were then considered as a Family in the *Neuroptera*. Pictet brought some order out of this chaos, dividing them into eight genera.

Kolenati, in 1848, carried the classification a stage further and created two main groups or sub-divisions based on the relative number of joints in the maxillary palpi in the two sexes. His first sub-division, the INAEQUIPALPIA, contains all the groups with species in which the number of joints are unequal in the two sexes, fewer in the male than in the female. In the second sub-division, the AEQUIPALPIA, are placed the groups whose species have an equal number of joints in both sexes. This was indeed a great step forward and his sub-divisions were retained both by McLachlan in his *Monographic Revision and Synopsis of the Trichoptera of the European Fauna* 1884 and also by Ulmer in the fascicule of the *Genera Insectorum* dealing with the *Trichoptera* 1907. It may be that this broad sub-division is artificial and perhaps not in true accord with the relationship of the various groups, now regarded as families since the *Trichoptera* have been elevated to an Order. Other

Trichopterists, notably Mr. A. B. Martynov in his *Practical Entomology* published in Russian in 1924, have not accepted this grouping on the ground that it disregards more important natural affinities. Possibly they may have reason. Nevertheless for the student, Kolenati's division has the merit of extreme simplicity whilst Martynov depends for the division of the *Trichoptera* into his sub-orders the ANNULIPALPIA and the INTEGRIPALPIA partly on the form and habits of the larvae which, in India at any rate are practically unknown, and partly on structures in the adult insect, some of which are very obscure. Moreover, the characters selected for the sub-orders are not invariably present in the Families they contain. To give an instance, the larvae in the ANNULIPALPIA are supposed to be all of non-case making habits. Yet the sub-order includes the HYDROPTILIDAE and the RHYACOPHILIDAE, the former *all* making cases as far as is at present known and certainly some of the latter such as *Agapetus* and its allied genera. Again, in the

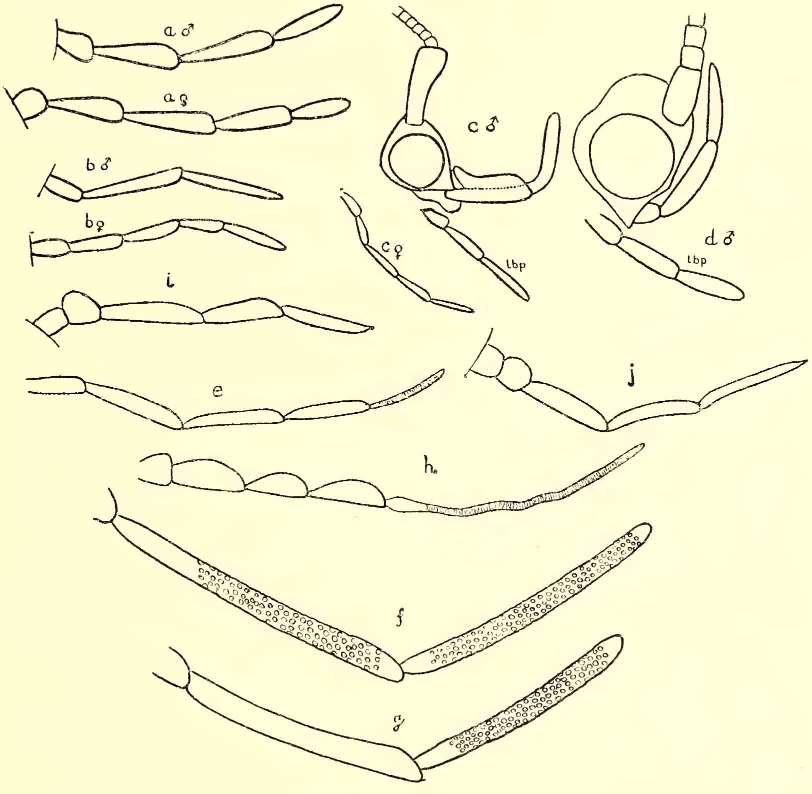

Fig. 8.—Forms of maxillary palpi.—
a ♂, *a* ♀ *Phryganeidae*; *b* ♂, *b* ♀ *Limnophilidae*; *c* ♂, *c* ♀ (*Lepidostoma*); *d* ♂ (*Micrasema*) *Sericostomatidae*; *e*, *Leptoceridae*; *f* and *g*, enlarged figures of terminal joints of the max. palpi of *f*, *Leptocerus annulicornis* and *g*, *Leptocerus albifrons*; *h*, *Hydropsychidae*; *i*, *Rhyacophilidae*; *j*, *Hydroptilidae*.

INTEGRIPALPIA, the discoidal cell is given as being 'rather long in the forewing'. But the sub-order includes the BERAEIDAE and the MOLANNIDAE in which the discoidal cell is entirely wanting and in some of the SERICOSTOMATIDAE, a family which is also included in this sub-order, the discoidal cell is very short, *Micrasema* for instance. Nevertheless, in spite of these objections his sub-orders are very natural and, for the advanced student, no doubt practicable. But, after due consideration I am convinced that, for the beginner it is better to retain Kolenati's old divisions and to follow the system adopted by Ulmer in the *Genera Insectorum*. The main thing with which we are here concerned is the correct determination of the insects we may capture and, for this, the easier method is undoubtedly the better even though it may be found wanting by the ultra-scientific school.

Throughout the *Trichoptera* the joints of the maxillary palpi in the female sex number five excepting in the genus *Anisocentropus* where they number six and in a few genera in the HYDROPSYCHIDAE where they are completely wanting in both sexes.

The INAEQUIPALPIA contains the following families:—

1 PHRYGANEIDAE.
2 LIMNOPHILIDAE.
3 SERICOSTOMATIDAE.

For these, McLachlan gives the following characters:—

1. Maxillary palpi of the male four jointed, only slightly pubescent, their form similar in both sexes. PHRYGANEIDAE Burm.

2. Maxillary palpi of the male three jointed, scarcely pubescent, their form similar in both sexes. LIMNOPHILIDAE Kol.

3. Maxillary palpi of the male two (?) or three jointed, ordinarily very pubescent or pilose and always formed in quite a different manner from those of the female, varying very greatly according to genus. SERICOSTOMATIDAE McL.

The AEQUIPALPIA contains the following families:—

4 BERAEIDAE.
5 MOLANNIDAE.
6 CALAMOCERATIDAE.
7 ODONTOCERIDAE.
8 LEPTOCERIDAE.
9 HYDROPSYCHIDAE.
10 POLYCENTROPIDAE.
11 PSYCHOMYIDAE.
12 PHILOPOTAMIDAE.
13 RHYACOPHILIDAE.
14 HYDROPTILIDAE.

As there are so many families in the AEQUIPALPIA, I will give here, for convenience, a modification of Ulmer's table in the *Genera Insectorum*, reserving the consideration of the family characters in greater detail until later.

AEQUIPALPIA.

Maxillary palpi five-jointed in both sexes excepting in some of the HYDROPSYCHIDAE genera in which they are entirely wanting in both male and female and also in the genus *Anisocentropus* where, in the female, the joints number six.

1. Insects very minute, very strongly pubescent; the wings with numerous erect hairs, fringes very long, those of the posterior wing longer than the greatest breadth of the wing; antennae short and stout, shorter in the ♀ than in the ♂, terminal joint of the maxillary palpus simple. 14 HYDROPTILIDAE Pict.

—Insects rarely small, generally medium sized or large, anterior wings without thick erect hairs, or at the most such hairs are thinly sprinkled; fringes of the posterior wing not as long as the breadth of the wing; antennae as long as or longer than the anterior wing, only very occasionally shorter. 2

2. Terminal joint of the maxillary palpi articulated (except in *Hyalopsychodes*), generally much longer than all the other joints together. 3

—Terminal joint not articulated, sometimes flexible, only a little, or not longer than the other joints together. 6

3. *Ocelli* present. 12 PHILOPOTAMIDAE Walleng.

—*Ocelli* absent. 4

4. Anterior tibiae generally with three spurs (in some species of *Ecnomus* only two). 10 POLYCENTROPIDAE Ulmer.

—Anterior tibiae with fewer than three spurs. 5

5. Fork 1 in the anterior wing present. 9 HYDROPSYCHIDAE Curtis.

—Fork 1 in the anterior wing (and in the posterior wing) absent. 11 PSYCHOMYIDAE Kol.

6. *Ocelli* present. 13 RHYACOPHILIDAE Stephens.

—*Ocelli* absent. 7

7. Median cell in the anterior wing closed. 6 CALAMOCERATIDAE Ulmer.

—Median cell in the anterior wing absent. 8

8. Discoidal cell in the anterior (and posterior) wing absent. 9

—Discoidal cell in the anterior wing present. 10

9. Spurs 2 4 4. 5 MOLANNIDAE Walleng.

—Spurs 2 2 4. 4 BERAEIDAE Walleng.

10. Fork 2 in the anterior wing present. 7 ODONTOCERIDAE Walleng.

—Fork 2 in the anterior wing generally absent (in *Triaenodes* and *Symphitoneuria* the apparent fork 2 is probably a false fork). 8 LEPTOCERIDAE Leach.

Many of the above families have been again split up into subfamilies. I will deal with these when later I am discussing their individual composition.

(*To be continued*).

SOME OBSERVATIONS ON THE GENUS *ARISAEMA* ON THE NILGIRI HILLS, SOUTH INDIA

BY

EDWARD BARNES, B.Sc. (Lond.).

(*With* 2 *plates*).

The South Indian species of this interesting genus do not appear to have received the attention that they deserve. Of the five species of *Arisaema* included in the Flora of the Presidency of Madras (Part IX by Mr. C. E. C. Fischer, published in 1931) *A. pulchrum* is known from only one specimen and *A. Wightii* until recently was known only from material 'all in a more or less dilapidated condition, hardly permitting a precise conception' (Fischer); and even the two very common species, *A. tortuosum*, Schott, and *A. Leschenaultii*, Blume, have received little attention in the field for many years. The collections made by the writer have resulted in the founding of four new species, descriptions of which have recently appeared or are in process of publication (*A. Barnesii*, Fischer, *A. translucens*, Fischer, *A. tylophorum*, Fischer, Kew Bull. 1933, 339, and *A. convolutum*, Fischer, in the press).[1] The observations recorded below include some additional information about these new species as well as some further obervations on several of the older ones.

DISTRIBUTION

In South India this genus is almost entirely confined to the higher hills.

On the Nilgiris by far the commonest species is *Arisaema Leschenaultii*, Blume. It is usually found in sholas, and there are very few sholas above 6,000 ft. in which it is not to be found. It generally grows on the ground in leaf-mould. A number of sholas on the Wenlock Downs show a remarkable absence of undergrowth; in these sholas *A. Leschenaultii* becomes epiphytic. An example that may be quoted is the shola on the side of Anikalbetta ('Staircase'), where at least 90 per cent of the plants of this species were found to be growing on moss-covered branches, in forks or on outstanding roots of trees. On some of the highest hills, such as Pichalbetta, its characteristic place of occurrence is on the margins of sholas or under the shade of bushes. In wet places it is not uncommon in the open amongst grass or in cracks between rocks. The spathe of *A. Leschenaultii* varies in colour from light green or yellowish-green striped with white to dark crimson-purple with lighter stripes. Generally those plants that grow in dense shade or in wet situations have spathes that are green and white while those that grow in dry or exposed places tend to have more or less purple spathes.

A. tortuosum, Schott, appears to be the most widely distributed species of this genus in India. It is found in dryer places and down to lower levels than the other species in the Nilgiris.

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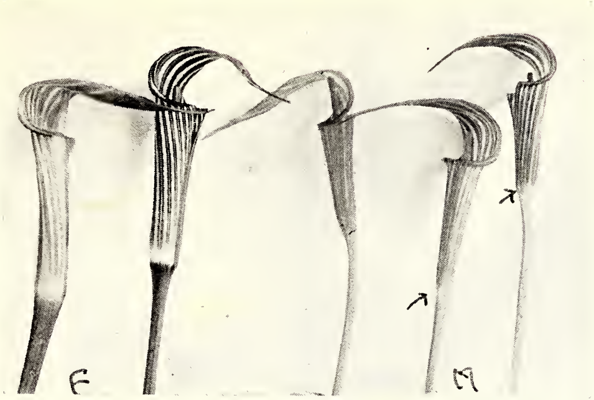
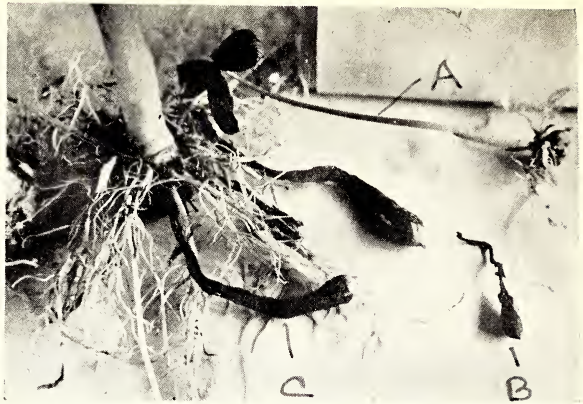
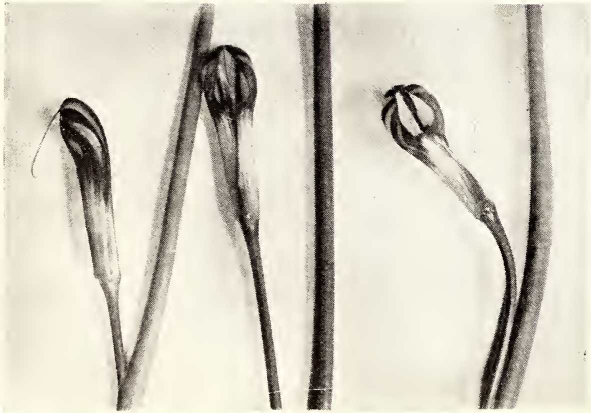
[1] Now published Kew Bull. 1934, 167,



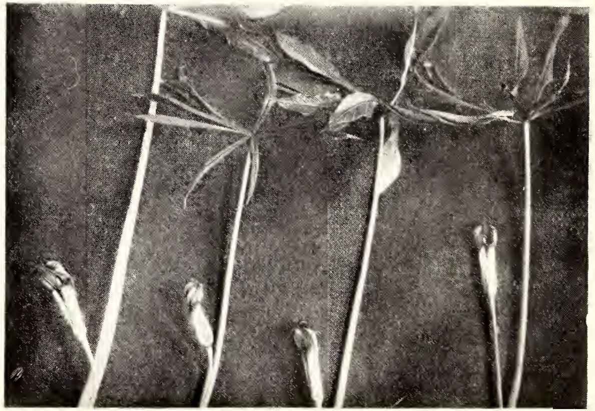
1. *Arisaema Leschenaultii* Blume.
Female and male inflorescences.



2. *Arisaema Leschenaultii* Blume.
A. Seedling. B. Detached corm.
C. Undetached corm.



3. *Arisaema translucens* Fischer.



4. *Arisaema translucens* Fischer.

It is not found much above 6,000 ft. except the non-typical form with five leaflets, which grows up to about 8,000 ft. It often grows in the open and is common on road sides and on the margins of clearings in sholas on the ghats. The colour of the spathe and appendage of the spadix varies from green or purplish-green to almost black.

A. Barnesii, Fischer, is not uncommon between 5,000 ft. and 6,500 ft. in sholas, but does not appear to occur at higher levels. It has been found in Longwood Shola, Kotagiri, near Pykara Falls, at Neduvattam and in Thiashola. It has been found only in the ground. The colour of the spathe varies from green with white stripes to dark purple with white stripes.

A. convolutum, Fischer, has been found to be common in several sholas above Parson's Valley, and a few specimens have been seen in Governor Shola near Ootacamund and on the sides of Emerald Valley. It appears to require a wet climate and a fairly high altitude (7,500 ft.). It grows both in leaf-mould on the ground and on moss-covered branches or roots of trees.

A. translucens, Fischer, has been found only in Thiashola and its neighbourhood. It is found amongst undergrowth in dry sholas down to about 5,500 ft. It was also found growing in cracks in rocks in a dry shola.

A. tylophorum, Fischer, has been found at Neduvattam, at the upper end of the Ouchterlony Valley and in Thiashola (6,000-7,000 ft.). It grows in the ground and is usually found on the edges or in the more open parts of sholas.

Except the non-typical form of *A. tortuosum* which flowers in March and April, all the above mentioned species of *Arisaema* flower in May and June on the Nilgiris.

Number of Leaflets

Below are given the results of counts made of all plants seen at the times and places mentioned. The number in the brackets is the number of leaflets, and the number before the bracket is the number of plants found to have that number of leaflets.

A. Leschenaultii. Longwood Shola. 27-5-32.

Each plant had one leaf.
Males: 2 (5), 5 (6), 96 (7), 80 (8), 50 (9), 16 (10), 4 (11).
Females: 3 (8) , 6 (9), 12 (10), 4 (11), 3 (12).
Number of leaves with odd number of leaflets: 168.
Number of leaves with even number of leaflets: 119.

A. tortuosum, typical form. Banagudi Shola. 18-6-32.

Each plant had two leaves.
Monoecious: 2 (7), 5 (8), 32 (9), 4 (10), 4 (11), 1 (12).
Males: 5 (5), 4 (6), 37 (7), 6 (8).
Number of leaves with odd number of leaflets: 78.
Number of leaves with even number of leaflets: 20.

Early flowering, non-typical form. Longwood Shola and Dodabetta. April 1933.

Each plant had two leaves with five leaflets.

This plant differs from the normal form in having pedatisect leaves always having five leaflets, in occurring at higher altitudes, in flowering in March and April, and in the spatheo becoming black on withering, and not yellow.

A. Barnesii, typical form. Thiashola at lower altitudes. 12-6-33.

Each plant had one leaf.

Males: 23 (5), 5 (6), 13 (7), 8 (8), 2 (9).

Females: 1 (7), 3 (8), 1 (10).

Non-typical form. Thiashola at higher altitudes. 12-6-33.

Males: 3 (5), 10 (7), 1 (8).

Females: 2 (7), 1 (9).

This plant differs from the typical form in the markings on the spathe, notably in the presence of a white patch at the base of the limb, and in the appendage becoming green and filamentous at the tip instead of ending in a knob. It may be a variety of *A. Barnesii* or, less probably, a cross between this species and *A. tylophorum* in which most of the characters of the former are dominant.

Species as a whole:

Number of leaves with odd number of leaflets: 67.

Number of leaves with even number of leaflets: 14.

A. convolutum. Pennant Shola, Nilgiri Downs. 21-5-33 and 3-6-33.

Each plant had one leaf.

Males: 1 (7), 4 (8), 11 (9), 11 (10), 7 (11), 2 (12), 1 (13).

Females: 2 (10), 4 (11), 6 (13), 1 (13), 1 (14), 1 (15).

Number of leaves with odd number of leaflets: 26.

Number of leaves with even number of leaflets: 26.

A. translucens. Thiashola. 9 and 12-6-33.

Each plant had one leaf.

Males: 2 (6), 7 (7), 9 (8), 15 (9), 11 (10), 3 (11).

Females: 3 (11), 5 (12).

Number of leaves with odd number of leaflets: 28.

Number of leaves with even number of leaflets: 27.

A. tylophorum. Thiashola 8-6-33 and Neduvattam 14-6-33.

Each plant had one leaf.

Males: 19 (5), 8 (6), 5 (7).

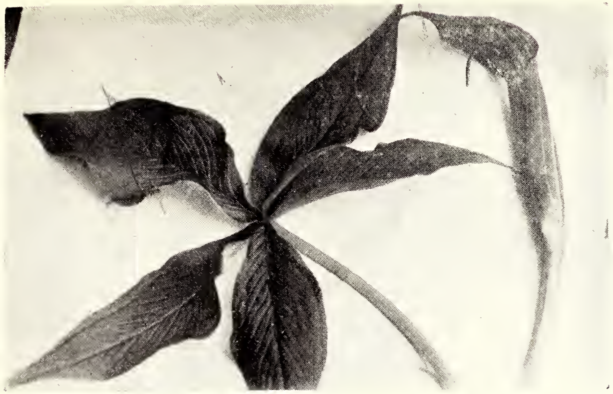
Females: 1 (5), 10 (6), 24 (7).

Number of leaves with odd number of leaflets: 49.

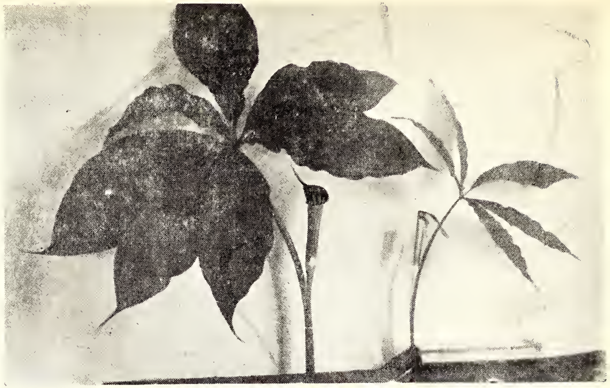
Number of leaves with even number of leaflets: 18.

(The proportion of plants having odd numbers of leaflets was considerably greater than is indicated by the above figures, as at the time of counting, the inflorescences of many male plants had disappeared. There were very many leaves with five leaflets, but it was not possible to be certain in many cases whether these were immature plants or males whose inflorescences had died off. Only plants with recognisable inflorescences were counted.)

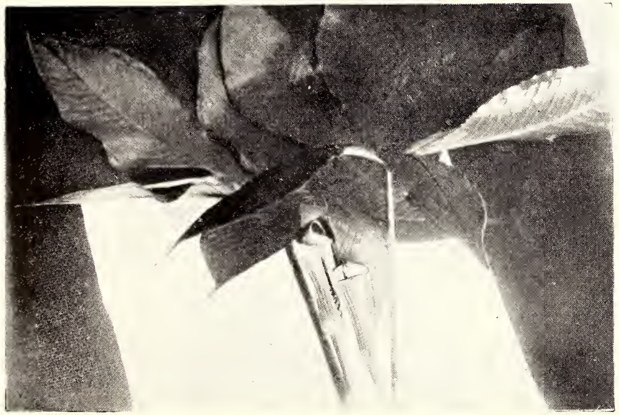
On examining these figures it will be seen that only in two species, *A. translucens* and *A. convolutum*, are there approxi-



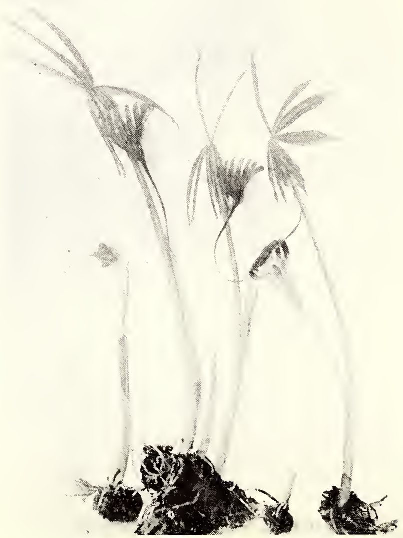
5. *Arisaema Wightii.*



6. *Arisaema Barnesii* Fischer.
Female left. Male right.



7. *Arisaema tylophorum* Fischer.



8. *Arisaema convolutum* Fischer.

mately equal numbers of leaves with an odd and an even number of leaflets. In these two species only may the leaves be regarded as strictly radiatisect, and even in these the leaflets are not all of exactly the same size. In the other species the leaves with an odd number of leaflets are in a large majority. The leaves of *A. Barnesii* and *A. tylophorum* are therefore to be regarded as palmate. *A. Wightii* has obviously palmate leaves. In the case of *A. Leschenaultii*, the count suggests that the palmate arrangement of the leaflets is not very pronounced; the leaflets are of slightly different size, but mere inspection gives the impression of a radiate leaf. *A. tortuosum* stands apart in having pedately arranged leaflets.

These results may be interesting in connection with the evolution of this genus. It appears probable that the species having most typically radiatisect leaves (*A. convolutum* and *A. translucens*) have evolved from plants having sagittate simple leaves, which are common in related genera, by way of genera having palmate leaves. This suggestion is supported by the fact that in *A. convolutum* and in *A. Leschenaultii* (and probably in other species) in the bud the leaflets are arranged in three groups, one at the end of the petiole and in a line with it, and one folded downwards on each side of the petiole.

PROPORTIONS BETWEEN THE SEXES

The following figures were obtained at the same times as those of the previous section.

A. Leschenaultii. This species is dioecious.

Female: 28.
Male: 253.

It is seen that nine times as many male as female inflorescences were found. It is thought that probably there is not a constant ratio between the sexes, but that the ratio varies with conditions. In making the count it was noticed that in moist and more favourable situations females were relatively more numerous than in dry places. In Governor Shola, which is much moister in May and June than Longwood Shola, no complete count was made, but females appeared to be almost as numerous as males.

A. tortuosum. Some inflorescences contain both male and female flowers, and others male only.

Monoecious: 24.
Male: 26.

A. Barnesii. This species is dioecious.

Typical:	Female: 5.	Male: 51.
Non-typical:	Female: 3.	Male: 14.

A. convolutum. This species is dioecious.

Female: 15.
Male: 37.

In this case males were certainly relatively more numerous than these figures indicate. Many leaves were seen without inflorescences; some of these were immature plants, but many were males whose inflorescences had died and disappeared, the leaf expanding fully later than the opening of the inflorescence in this species.

A. translucens. This species is dioecious.
Female: 8.
Male: 47.

A. tylophorum. This species is dioecious.
Female: 35.
Male: 32.

This count was taken too late in the season when many male inflorescences had disappeared. Almost certainly males outnumber females.

It is seen that in the dioecious species, with the possible exception of *A. tylophorum*, the male inflorescences greatly outnumber the females. In the case of *A. tortuosum* there are almost equal numbers of male and monoecious inflorescences.

FERTILISATION

A. Leschenaultii. In this species at the bottom of the tube of the spathe in front where the edges overlap, it will be noticed that in the male inflorescence the two edges arch away from one another so as to form a small roundish orifice about 1 x 2 mm. in medium-sized plants (Fig. 1). The male flowers do not extend to the bottom of the spadix, but there is a bare space at the base of the column. At the same level the spathe is slightly dilated. There is thus an annular space at the bottom of the inflorescence for which the orifice referred to acts as an exit. In the case of the female inflorescence there is no definite orifice at the base of the spathe, but the outer edge of the spathe is slightly thickened and presses firmly on the under edge and overlaps it to a greater extent than in the case of male spathes. The female flowers also extend to the bottom of the column in most cases so that there is no free annular space, or only a very narrow one. The way in which these modifications of the spathe aid cross-fertilisation appears to be as follows. An insect entering a male inflorescence is able, if not too large, to crawl down the spadix to the bottom, and by way of the annular space get to the orifice and escape. It is probable that insects crawl down the spadix and not down the inner side of the spathe as the surface of the latter is very smooth (and, incidentally, not wetted by water). The obvious purpose of the appendage of the spadix appears to be to attract insects and lead them to the fertile parts of the inflorescence. In a well-developed male inflorescence of about average size there were found to be 130 male flowers each consisting of 3 or 4 stamens. The male flowers at the middle of the fertile part of the spadix ripen first, then those lower down, and lastly the uppermost. The indehisced anthers contain so much pollen that they are distended to about three times the diameter of the empty cell. When the ripe anther is touched, the pollen is exuded in great quantity through a slit in the top. So much pollen is produced that by the time all anthers have dehisced the annular space at the bottom of the inflorescence is usually choked with it. An insect that enters the inflorescence and makes its escape by the orifice will therefore almost certainly carry away a good deal of pollen with it. If in crawling down the spadix it does not get covered with pollen from the dehiscing anthers with which it comes into contact, it will do so in wading through the pollen in the annular space at the bottom. Should such an insect now enter a female inflorescence it will crawl down the appendage of the spadix to the female flowers. The ovaries are packed tightly together and the insect will have to pass between two rows of stigmas. Before reaching the bottom, however, it will get jammed, as space becomes more and more restricted owing to the conical shape of the column on which the female flowers are packed. In its struggles to escape, the insect is very likely to scatter a good deal of the pollen it is carrying onto the stigmas in its neighbourhood. Numerous insects thus caught are found in almost every female inflorescence after it has been open for a few days. A collection of such insects was forwarded to the British Museum and Dr. F. W. Edwards has very kindly furnished the following determinations.

Tube A.

Contains 6 species of *Mycetophilidae*:

Platyura sp. 1,	2 specimens.
Acnemia sp.,	1 specimen.
Phronia sp.,	5 specimens.
Mycetophila sp.,	1 specimen.
Delopsis sp. 1,	1 specimen.
Delopsis sp. 2,	1 specimen.

Tube B.

Contains the following *Diptera*:

Mycetophilidae.

Platyura sp. 1,	1 specimen.
Platyura sp. 2,	1 specimen.
Sciophila sp.,	1 specimen.
Sciara (at least 3 spp.),	12 specimens.

Dolichopodidae.

Psilopus sp., 2 specimens.
Neurigona sp., 1 specimen.

Phoridae.

Gen. indet., sp. 4, 1 specimen of each.

Acalyptrata.

Gen. indet., sp. 2, 1 specimen of each.

Also 3 small *Homoptera* (2 species).

The flies in Tube A were all small enough to be able to escape from the male inflorescence by way of the aperture at the base of the spathe. It appears probable therefore that some or all of these insects are concerned in cross-fertilisation of this species of *Arisaema*.

The insects in Tube B were all of such a size that they would not be able to escape from a normal sized male inflorescence by way of the aperture. They would therefore appear to be casual visitors and not usually concerned in cross-fertilisation. In addition to these insects a number of other visitors are frequently found in the inflorescences. A small spider finds them a good hunting ground, a cricket appears to use them to shelter in and a small caterpillar finds in them a suitable place for pupation.

On the female spadix above the fertile flowers there are almost always a number of filiform neuters. The uppermost of these are often turned upwards at some distance from the end. These neuters probably act as an obstacle to large insects which, as they are not likely to be carrying pollen, are to be excluded, for they are likely to damage the female flowers or at least to act as obstructions. Neuters are very rarely found on male spadices.

The large excess of male inflorescences (see previous section) makes it likely that many of the smaller insects that enter a female inflorescence will have previously been in a male inflorescence. The length of time the inflorescences remain open probably varies with elevation and weather. A male inflorescence observed lasted 10 days and a female one showed no signs of being over after an equal length of time. This long period of activity will also help to insure efficient cross-fertilisation. That cross-fertilisation is successfully brought about is shown by the high percentage of ovaries that develop. In a plant that was examined it was found that out of 155 ovaries all were developing except three, and these developing berries contained 1-7 seeds, mostly 3, 4 or 5. Two female inflorescences examined had respectively 7 and 12 neuters and 125 and 198 female flowers which contained up to 9 ovules.

The inflorescences of all the species of *Arisaema* referred to in these notes have an unpleasant smell, which is doubtless for the purpose of attracting the flies concerned in their cross-fertilisation. In many specimens the smell is not very strong and it is difficult to locate the place of origin of the smell. In some large specimens of *A. Leschenaultii* found in Thiashola which had dark purple spathes and very stout appendages to the spadix, the smell was very strong. By cutting off the spathe at the base and smelling the various parts of the inflorescence, it was found that the smell came from the appendage of the spadix. By contact with the appendage the upper part of the tube of the spathe had also acquired the smell, but other parts appeared to be free from it. The pendant acuminate or caudate end of the limb of the spathe probably serves as a first alighting place for the attracted flies. What induces the flies to penetrate to the bottom of the inflorescence is not obvious.

A. tortuosum. In this species there is an aperture at the base of the spathes of both the male and the monoecious inflorescences. The probability of cross-fertilisation taking place is obviously increased if the insect is able to escape from one monoecious inflorescence and enter another.

As in *A. Leschenaultii* the smell is definitely associated with the appendage of the spadix. Here the long exserted appendage serves both as an attraction to the flies because of its smell, and as an alighting place for them. The lowest male flowers ripen first. Ovaries contain up to 7 ovules. Three ripening spadices had 112, 141 and 167 berries, which mostly contained 3, 4 or 5 seeds.

A. translucens and *A. Barnesii.* In these species there is an orifice at the base of the male spathe but not in the case of the female. The general scheme for cross-fertilisation is probably like that in *A. Leschenaultii.* The smell was not sufficiently strong in the specimens examined and the parts were too small for the locating of the source of the smell. In the non-typical form of *A. Barnesii* female inflorescences had about 100 ovaries containing 4-8 ovules. The berries contained one or two seeds.

A. convolutum. In this species there is a definite orifice at the base of the male spathe, but not at the base of the female. Cross-fertilisation is probably brought about as in *A. Leschenaultii.* In contrast with *A. Leschenaultii* and *A. tortuosum,* in this case it is the very long tail of the limb of the spathe that is the source of the very unpleasant smell that the inflorescence has; this tail also serves as a settling place for the flies that are attracted.

One plant had 185 female flowers and the ovaries contained up to 4 ovules.

A. tylophorum. In this species the base of the spathe in both male and female inflorescences is dilated. There is a definite aperture in the case of the male spathe and apparently one in the female, but observations are incomplete. There are fewer flowers to an inflorescence in this species than in the others—about 60-80 in both male and female—and it appears probable that the scheme of cross-fertilisation is not quite the same as with *A. Leschenaultii.* The inflorescences have only a faint smell and its location could not be determined. There are usually 6 ovules in each ovary, sometimes 5 or 4. There are usually 1 or 2 seeds in each berry, occasionally three.

In each of these species the pollen consists of spherical bodies 0.015-0.02 mm. in diameter: in *A. Leschenaultii, A. Barnesii* and *A. translucens* the surface of the grains is slightly echinate; in *A. tortuosum, A. tylophorum* and *A. convolutum* it is granular.

Folding of the Spathe

In this genus one side of the spathe overlaps the other side. It was thought that it would be of interest to find whether, as in certain twining plants, some species are right-handed and others left-handed.

The following figures were obtained:—

	Right	*Left*
A. Leschenaultii	66	52
A. tortuosum	22	6
A. Barnesii	27	29
A. convolutum	14	15
A. translucens	23	30
A. tylophorum	36	25

(Right means the side of the spathe on the observer's right overlaps the other side, and left the opposite. No distinction is made between males and females in this count.)

It is quite definite that none of these species is completely right- or left-handed. In the cases of *A. Barnesii* and *A. convolutum* the right side is the outer as often as the left. The right side appears to overlap the left more often than the reverse in *A. Leschenaultii*, *A. tortuosum* and *A. tylophorum*, and the opposite is the case with *A. translucens*. Whether the statements made in the last sentence would be confirmed if sufficiently large numbers were counted appears to be somewhat doubtful.

Root and Vegetative Reproduction

In *A. Leschenaultii* there is a corm, oblately spherical in shape and up to about 2 in. in diameter in normal-sized specimens. The under surface is very much puckered and pale green in colour. Dissection shows that this puckered surface is that of the corm of the previous season. In May it is only about $\frac{1}{8}$ in. thick and easily separates leaving the surface of the new corm white and smooth. The foot of the stem is broadened where it joins the corm and from this broadened base there emerge about 20 stout fleshy roots. These roots radiate more or less horizontally. They have numerous branches and these are provided with root hairs. The surface of the main roots is puckered transversely for its first inch or two and is pinkish, this colour being due to numerous minute pinkish-purple longitudinal dashes. The finer roots are white and the root tips yellow. The lowest part of the stem is covered with a brown membranous skin broken irregularly along its upper edge. Above and within this there are three or more membranous blunt-tipped leaves clasping the stem; these vary in colour from white below to dark purple above. From the outer edge of the corm at a slightly lower level than that at which the roots emerge, and originating apparently from the old corm, several underground stems grow out. These run horizontally for about 4 ins. and the tip enlarges till it is about $\frac{1}{2}$ in. in diameter. The greater part of the stem then shrivels and the enlarged part forms a new corm. The horizontal stems and the enlarged ends are covered with membranous blunt-tipped scales which are brown, except the two end ones which cover the bud on the corm, and these are light purple. The newly-formed corm is pear-shaped and lies horizontally with the bud at the blunt end and the residue of the stem at its narrow end. Apparently these corms produce only a leaf next season and establish a larger corm, and produce an inflorescence only in a subsequent season.

In *A. tortuosum* the under side of the corm is covered with the cream-coloured shrivelling residue of the corm of the previous season. Embedded in this old corm near its edges there are to be found several small spherical white corms. These have their bluntly conical buds facing upwards. Round the bottom of the stem just above the level at which the roots emerge small buds are found. It appears, therefore, that in this species the new corms take two years to form, being present as buds on the side of the mature corm one year and developing in the residue of that corm the next season.

In *A. convolutum* small upward-pointing corms were found round the upper part of the mature corm. An immature plant growing near a mature one had a corm about ¾ in. in diameter. On one side of this small corm there was a brown shrivelled stem which tapered down to about ⅛ in. in diameter. This narrow end was near the upper part of the corm of the mature plant and had evidently grown out of it although connection had now ceased. Whether the underground stem and the small corm on the side of the mature one are somewhat different modes of reproduction or only stages of the same mode is not certain.

In the case of *A. translucens* underground stems developing into corms are also found. In June stems were found about 5 ins. long; the forward 1½ ins. was enlarged to about ½ in. in diameter and the other part was shrivelling. The widened end was dark green with purple markings, and narrowed suddenly to a long point. Round the terminal bud there were a few membranous scales and behind these a few white root-tips were emerging.

In the case of *A. tylophorum* there were small corms emerging from the upper part of the mature corm at a slightly higher level than the roots. These were found on immature plants that had not yet produced an inflorescence as well as on mature male and female plants. No underground stems were found and the fact that the small corms had their tips pointing upwards suggests that they develop beside the parent plant. Small corms with tips upwards were also found round the upper part of the mature corm in *A. Barnesii.*

WANDERINGS OF THE BOMBAY-DUCK, *HARPODON NEHEREUS* (HAM. BUCH.), IN INDIAN WATERS.

BY

SUNDER LAL HORA, D.SC., F.R.S.E., F.A.S.B.

Assistant Superintendent, Zoological Survey of India, Calcutta.

(*With 8 text-figures*).

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TAXONOMY.

The first scientific reference to the fish known as 'Bombay-Duck' is found in Hamilton's *Gangetic Fishes.*[1] The species was discovered[2] by him 'in the mouths of the Ganges', and doubtfully referred to the genus *Osmerus*. In 1825, however, La Sueur[3] proposed the genus *Harpodon* for his *Salmo microps*, which, later on, proved to be synonymous with *Osmerus? nehereus* Ham. Buch. As often happens, the fish was described under various names by different ichthyologists till the present name—*Harpodon nehereus* (Ham. Buch.)—was assignd to it by the famous ichthyologist Dr. A. Günther in his *Catalogue of Fishes in the British Museum* (vol. v, p. 401, 1864). Since its discovery, the fish has been found in widely separated localities and its range is now known to extend 'from Zanzibar to China, seas and estuaries of India, most common at Bombay but decreasing in numbers down the Malabar Coast. It is not very common at Madras but augments in numbers up the Coromandal Coast, being very abundant in the rivers and estuaries of Bengal and Burmah. Bleeker observes that it appears to be very abundant in the straits of Malacca, more rare at Java, and uncommon at Batavia.'[4] For a considerable time, the genus *Harpodon* remained monotypic and was included in the family *Scopelidae*, comprising exclusively marine, pelagic or deep-sea fishes. In 1881, Günther[5] described another species from a single specimen, 27 inches long, obtained at Tokyo by the Challenger Expedition as *H. microchir* and remarked, 'although it is not known at what depth the fish was obtained, it is evident from its organisation that it should be referred to the deep-sea fauna'. A few years later, a third species, *H. squamosus* was described by Alcock[1] from the Bay of Bengal occurring at depths ranging from '240 to 276 and 281 to 258 fathoms'. Quite recently a new species, *H. mortenseni*, has been described by Hardenberg[2] from the Bali Sea from a depth of 300 meters.

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[1] Hamilton, "*Gangetic Fishes*", p. 209 (Edinburgh, 1822).

[2] In the 'Original Notes' concerning the *Gangetic Fishes* the description of the species is dated 'Botanical Gardens, 29th January, 1815'.

[3] La Sueur, *Journ. Acad. Nat. Sci. Philadelphia*, v, p. 50 (1825).

[4] Day, *Fish India*, p. 506, pl. cxviii, fig. 1 (1877).

[5] Günther, *Rep. Sci. Res. Challenger*, xxii, p. 180, pl. xlvii, fig. A (1887).

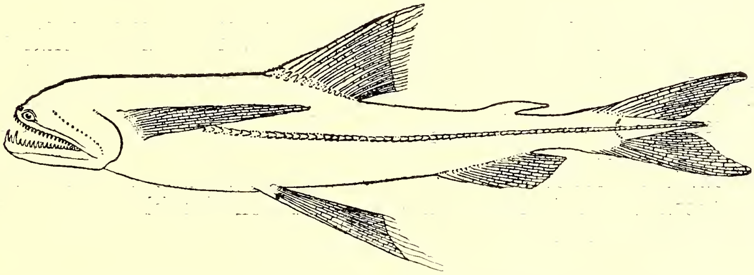

Fig. 1.—Lateral view of a young specimen of *Harpodon nehereus* (Ham. Buch.). ×$\frac{2}{3}$.

Bombay-Ducks are elongate and rather compressed fishes, in which the head is thick, short and provided with a very short rounded snout. The scales are cycloid and deciduous. A lateral line is present. The cleft of the mouth is very wide and is bordered above by the slender, long intermaxillary bone; the maxillary bone is absent. The lower jaw is prominent. Both the jaws are provided with unequal, partly covered, subulate and depressible teeth in a band; the inner teeth, especially in the lower jaw, are enlarged and conspicuously hastate. There are similar teeth in one or two rows on the vomer, palatines, pterygoids, tongue and branchial arches. The dorsal fin is in the middle of the length without the caudal, and there is also a narrow adipose fin opposite to the middle of the anal fin. The caudal fin is three-lobed. The ventral fins are exceedingly long. The gill-openings are extremely wide and are covered with membranous opercula. The branchiostegal membranes are free and extend beyond the opercula. There are 17 to 25 branchiostegal rays.

The exact affinities of this remarkable genus are not well known, but it is no longer included in the family *Scopelidae*. Goode and Bean[3] and Regan[4] refer it to the family *Synodontidae* (*Synodon*, *Saurida*, *Bathysaurus* and *Harpodon*), while Jordan[5] has proposed a new family for this genus. Weber and Beaufort[1] have treated the genus under the order *Myctophoidea* and finding 'no concordance among ichthyologists' regarding the forms treated under Iniomi, they have not grouped the Indo-Australian genera into families.

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[1] Alcock, *Ann. Mag. Nat. Hist.*, p. 127 (1891); *Ill. Zool. Investigator*, pl. xxx, fig. 1.

[2] Hardenberg, *Treubia*, xiv, pp. 221-222, fig. 1 (1934).

[3] Goode & Bean, *Oceanic Ichthyology*, p. 59 (Washington, 1895).

[4] Regan, 'Fishes' in *Encyclopaedia Britannica*, 14th ed., ix (1929).

[5] Jordan, *Classification of Fishes*, p. 154 (California, 1923).

Harpodon nehereus, when fresh, is said to be brilliantly phosphorescent all over the body, but Kemp[2] by his observations on specimens from the Matlah River was not able to corroborate this statement. It shows some curious features that resemble adaptations to deep-sea existence, though it is remarkable that the fish is not known to occur at any great depth. Still further remarkable is the fact that it is not even restricted to the sea, being very abundant in the estuaries of Bengal and Burma. In its gelatinous consistency and large mouth with the lower jaw loosely articulated and furnished with recurved teeth, it resembles the deep-sea species. This resemblance to a deep-sea form misled even so great an authority as Günther, for in his *Study of Fishes* (p. 584, 1880) he remarked, in reference to the two species of *Harpodon* known to him, that 'both are evidently inhabitants of considerable depths, and periodically come nearer to the surface'.

Fishing in Indian Waters.

In a recent article on the 'Fishing for "Bombay-Duck" ', Setna[3] has made some observations on the movements of this fish. He remarks that 'the peak period of the fishing season in Bombay (for "Bombay-Duck") is from June to September, and at this time the inshore waters are the haunts of innumerable kinds of fishes, both large and small, and crustaceans'. Towards the close of the monsoon season, the quantity of the catches of this fish falls off very sharply and inshore fishing is gradually discontinued. In October, it is not worth while to fish for them. After October and till the commencement of the south-west monsoon, the fish is still available in fair quantities but in places about 20 to 25 miles from Bombay. Here they are netted to be discarded as they are liable to putrefy by the time the boats reach the shore, as they have to beat up against the north-east monsoon at this period. According to the statistics collected by Setna, the fish is most abundant in Bombay during September.

The principal fishery of the Bombay-Duck is at the entrance of the Bombay harbour where the water is about 40 to 60 feet deep and the bottom of the sea consists largely of sandy banks. As a result of the trawling on the Western Coast by *William Carrick*, Hefford[4] found that *Harpodon nehereus* was sometimes taken in fair quantities, especially in the shallower water, but it suffered a great deal of damage in the trawl and it was considered profitless to keep it for market. It is unfortunate that no statistics were kept by Hefford regarding its distribution in Bombay waters and the seasons of its occurrence.

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[1] Weber and Beaufort, *Fish Indo-Austral. Archipel.*, ii, pp. 139, 150 (Leiden, 1913).

[2] Kemp, *Rec. Ind. Mus.*, xiii, p. 238 (1917).

[3] Setna, *Journ., Bombay Nat. Hist. Soc.*, xxxv, pp. 867-872 (1932).

[4] Hefford, *Report on the Work of the Steam Trawler 'William Carrick'*, May 1921 to February 1922, p. 31 (Bombay, 1923).

Dr. S. B. Setna informs me that he has been examining the gonads of this fish during the intensive fishing season off the Bombay Coast and can say with certainty that the gonads are not ripe at any time during June to October, whereas the fish examined in February and March were full of ripe eggs and active spermatozoa. These ripe specimens were taken far out at sea. Females with eggs were taken mostly in November and December while the young fish have been observed mainly in January and February.

According to Sorley,[1] the chief fishing grounds for *Harpodon nehereus* in the Bombay Presidency are in the area off Bombay extending northwards towards the Gulf of Cambay. In this region Bombay-Duck appears to be one of the commonest fish. On the south side of Bombay, the waters are deficient in this species and no regular fishing for it exists. Sorley states that in the Konkan area Bombay-Ducks usually appear in October to December and March to May when they 'come in shoals landwards to escape predaceous fish that pursue them'. From his enquiries, Sorley is led to believe that Bombay-Duck would be found to have a distinct oceanographical distribution.

In the Madras waters, *H. nehereus* is found in fair numbers at the mouths and in the estuaries of the Kistna and Godavari Rivers and along the Ganjam Coast. In 1916, Govindan[2] recorded that this species is not brought to the yards on the west coast, whereas on the east coast the curing yards at Calingapatam, Kommaravanipeta and Pukkillapeta in the extreme south coastal region of the Ganjam District receive it throughout the year. Hornell[3] in his statistical analysis of the fishing industry at Tuticorin makes no mention of *H. nehereus* among the principal food fishes that are caught there. Similarly Nayudu,[4] in his statistical analysis of an inshore fishing experiment at Madras during 1919, does not record this species in catches from Rayapuram. Moses,[5] while investigating the fish supply of Madras, found that 'Vangaravasi (*Harpodon nehereus*), the Bombay-Duck, is a rare fish, 10 lb. having been available in March'. Mr. P. E. P. Deraniyagala of the Department of Fisheries, Ceylon, has informed me that 'the fish known as Bombay-Duck "*Harpodon nehereus*" has never been captured by us when trawling on Pedro or Wadge banks. . . . I have never noticed it at any of our fish markets.' These observations indicate that the species is very rare, if not totally absent, from the Malabar Coast and the Coromandel Coast as far up as Madras, while at the mouths of large rivers northwards and along the Ganjam Coast it makes its appearance in sufficient numbers to be of some commercial importance.

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[1] Sorley, *The Marine Fisheries of the Bombay Presidency* (Bombay, 1933).

[2] Govindan, *Madras Fish. Bull.*, ix (1916).

[3] Hornell, *Madras Fish. Bull.*, ix (1916).

[4] Nayudu, *Madras Fish. Bull.*, xi, pp. 61-119 (1917).

[5] Moses, *Madras Fish. Bull.*, xv, pp. 131-166 (1922).

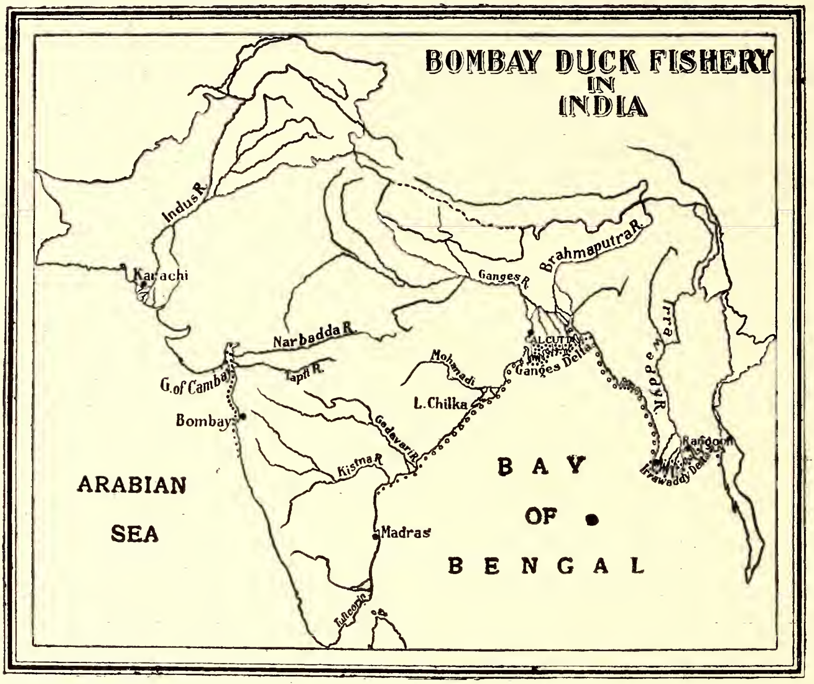
BOMBAY DUCK FISHERY IN INDIA
Indus R.
Karachi
Brahmaputra R.
Ganges R.
Narbadda R.
Tapti R.
G. of Cambay
Bombay
Calcutta
Ganges Delta
Mohanadi
L. Chilka
Godavari R.
Kistna R.
Madras
Irrawaddy R.
Rangoon
Irrawaddy Delta
ARABIAN SEA
BAY OF BENGAL

Fig. 2.—Chart showing principal centres of Bombay-Duck fishery in India.
● shows abundance of fish.
O shows possible occurrence of fish.

In Bengal, so far as I have been able to ascertain, *Harpodon nehereus* is not sold inland either in the fresh or dried condition. The fish is so delicate and the means of conveyance so primitive that it is not even brought to the Calcutta market from the lower reaches of the Gangetic Delta. At Chittagong, Noakhali and Bakargang 'the fish is largely caught and sold, and is esteemed as a good fish by all classes, both as fresh or dried.'[1] Gupta[2] in his preliminary report on the fisheries of Bengal mentioned *Harpodon nehereus* as one of the fish commonly caught in the estuaries and remarked that 'Bombay-Duck (*Harpodon nehereus*) is by no means rare, especially at the Sandheads; if it could be brought into Calcutta fresh, it would find a ready market'. As a result of the trawling operations of the 'Golden Crown', it was ascertained that *Harpodon nehereus* is more abundant round the Mutlah light vessel and right away to the westward of it past the entrance to the Eastern Channel down to the vicinity of the Pilot's Ridge.

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[1] De, *Report on the Fisheries of Eastern Bengal and Assam*, p. 26 (Shillong, 1910).

[2] Gupta, *Coll. Papers Fish. Surv. Bengal*, pp. 2, 6 (Calcutta, 1911).

Jenkins[1] considered the species as 'a true estuarine form, the young of which are found all over the Sunderbans in brackish water'. From the details of the fish caught by the 'Golden Crown', it appears that the species was obtained in sufficient numbers to be recorded for commercial purposes only during trips 8, 9, 10 and 27. Though during the first three of these trips the trawler worked on the Orissa Coast between Konarak (Black Pagoda) and Puri, the Bummaloes seem to have been obtained during its passage up and down the estuary. During trip number 27, the 'Golden Crown' trawled off the entrance to the Eastern Channel, on Pilot's Ridge, off the Devi River, off Konarak and then again off the Eastern Channel. Details of the catches of Bombay-Duck made by the 'Golden Crown' are given below:—

No. of trip.	Time of the year.	Quantity in lbs.
8th	1st to 5th October, 1908.	450
9th	11th to 15th October, 1908.	350
10th	22nd to 29th October, 1908.	315
27th	24th November to 3rd December, 1909.	100

According to Southwell,[2] Bombay-Duck is 'very plentiful in the river between the sea and Diamond Harbour; in the vicinity of the latter place it was scarce and ten miles further north entirely absent'.

I am informed by the fishermen of Port Canning (Matlah River) that *Bummalo* is to be found in the Matlah River in fair quantities during the cold season from November to February, and that it disappears during the rainy season. Both young and adult forms are found. While investigating the brackish water fauna of the Piali Nadi at Uttarbhag, 25 miles from Calcutta, it was observed that in February to March large quantities of *Harpodon nehereus*, mostly young, were captured during spring tides, while at other periods the fish was absent or very rare in the fish market.

For an ecological account of the estuarine area reference may be made to Kemp's[1] paper on the fauna of the Matlah River. There are two main factors in this environment, the nature of the bottom which consists of very finely divided, soft mud and the seasonal variation in the salinity of these waters from almost fresh to highly brackish. In December 1915, Kemp found *Harpodon nehereus* fairly abundant in the Matlah River, where the conditions for its existence are very similar to those prevailing in the deep-sea. The bottom fauna of the Matlah River, including

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[1] Jenkins, *Coll. Papers Fish. Surv. Bengal*, p. 66 (1911).

[2] Southwell, *Rec. Ind. Mus.*, xi, p. 329 (1915).

[3] Kemp, *Rec. Ind. Mus.*, xiii, pp. 233-241 (1917).

Harpodon nehereus, has a superficial resemblance to the deep-sea fauna.

H. nehereus is found in fairly large numbers along the coast of Burma but is chiefly caught at Akyab and in the deltaic region of the Irrawaddi. Unfortunately I have not been able to find any reference to the fishery of this species along the Burmese Coast so it is not possible to give statistics of catches.

The Secretary to the Financial Commissioner, Burma, informs me that 'the fish known as Bombay-Duck (locally known as *Baraga*) are not found in large numbers in this province. They are found in estuaries and salt-water areas of some of the rivers in the Arakan Division mainly during the cold weather. There are no fishing centres for these fish, but they are occasionally caught in nets though they form only a very small proportion of the catches. The fish apparently live in the open sea but go up and down the river with the tide. Akyab is the only district in which they are found in numbers: even in that district it is reported that most of the Bombay-Duck (dried) sold in the bazaars are imported from Chittagong.'

It is clear from the above that the roaming movements of *Harpodon nehereus* are not connected with the reproduction of the species, and, therefore, in the strictest sense, are not migratory. The bionomics of the species are not known. We do not know from where they come and are not acquainted with their usual breeding haunts. The structural features of the body indicate a deep-sea habitat, but we have no knowledge of the fact whether it is a deep-sea or a surface species. Its occurrence round our shores and the fact that Bombay-Ducks are available in Bombay and the estuaries of larger rivers all the year round render the study of the bionomics of the species of special interest. The elucidation of the breeding habits and bionomics of *Harpodon nehereus* will throw a considerable light on the relative merits of the two opposing conceptions in organic evolution—adaptation and predetermination.

Food of *Harpodon nehereus* (H. B.).

So far as I am aware no observations exist on the food of *Harpodon nehereus*. At my request Dr. S. B. Setna sent me two samples of the stomach contents of this species which have shown that *H. nehereus* feeds mainly on small fish and shrimps. The analysis of the fish removed from the stomach of *H. nehereus* has yielded the following results:—

2 young specimens, 30 and 35 mm. long.	*Harpodon nehereus* (H. B.).
1 young specimen, 66 mm. long.	*Trichiurus* sp.
2 young specimens, 35 mm. long.	*Engraulis* sp.
38 specimens, 15 mm. to 70 mm. long.	*Bregmaceros macclellandi* Thomson.

Among shrimps the principal food-species is *Acetes indicus* Milne-Edwards which is represented in the stomach contents by hundreds of specimens. Some larger Palaemonid and Peneid shrimps were also found but their number is insignificant. A young cuttle-fish was also present among the stomach contents of *H. nehereus*.

It is clear from the above that *Bregmaceros macclellandi* and *Acetes indicus* are the two principal food-species of *H. nehereus.*

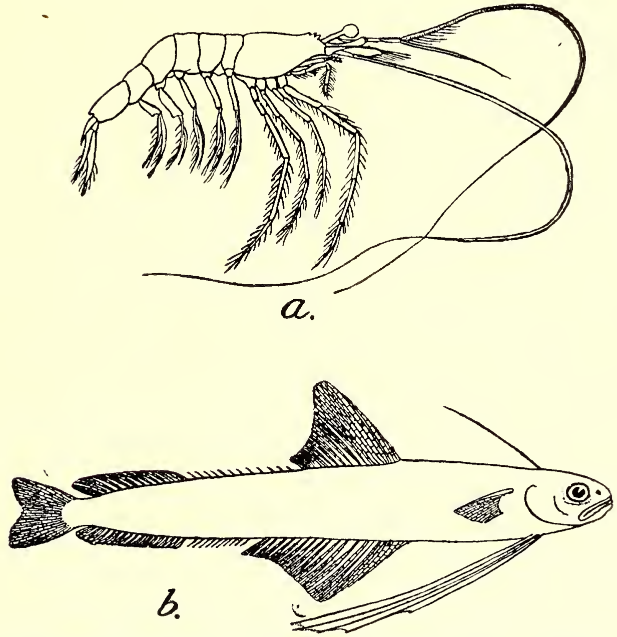

Fig. 3.—Principal food-species of *Harpodon nehereus* (Ham. Buch.).
a. Lateral view of *Acetes indicus* Milne-Edwards (Modified after Milne-Edwards).
b. Lateral view of *Bregmaceros macclellandi* Thompson (Modified after Weber & Beaufort).

B. macclellandi is a small species which is said to grow to about three inches in length; it is found in the mouths of rivers and along the coasts of India to China and the Philippine Islands. *Acetes indicus* is found at Bombay, in the Bay of Bengal and the Gulf of Siam; it is mainly found in brackish waters but also occurs in the open sea near land. It will thus be seen that the range of distribution of the two principal food-species is co-extensive with that of *H. nehereus* and it seems probable that the wanderings of the Bombay-Duck are influenced by the wanderings of the food-species. The subject deserves closer investigation.

Explanation of the Seasonal Occurrence and Distribution of *Harpodon nehereus* in Indian Waters.

From the foregoing account it is clear that *Harpodon nehereus* is numerous in the Gulf of Cambay and down the coast as far as Bombay, becomes rarer all down the Malabar Coast, is absent at Tuticorin and in Ceylon Waters, a few are taken at Madras but it increases largely in numbers along the Golconda Coast and is numerous again along the coasts of Bengal and Burma where it ascends the estuaries of the larger rivers. At Bombay it is found near the coast during the monsoon season and is most abundant in September, but in the estuaries and near the mouths of larger rivers it is found throughout the year. Jenkins found a large number of young specimens in the Gangetic Delta and regarded the species as an estuarine form.

The explanation of the mass-movements of *Harpodon nehereus* as depicted above is not clear. It is believed that the species visits our shores and estuaries in quest of food and its movements appear to be governed by the movements of its food-species, such as small fish, shrimps, prawns and other small crustaceans that have been found in its stomach. It is clear, therefore, that to elucidate the wanderings of this species it is essential to study the movements of the fish and crustaceans that constitute its food. Such a study will probably reveal further complications. The disturbance of one factor upsets an entire association, and it is probable that the mass-movements of the Bombay-Duck will ultimately be found to be induced by marked changes in the physical conditions of our shore-waters.

The study of the distribution of the fishery of Bombay-Duck in Indian Waters shows that there is one obvious factor, the effect of low salinity due to rains or to the water discharged by larger rivers, that can account for the discontinuous distribution of the species.

As is well known, during the monsoon months—June to October—Bombay receives heavy rainfall and in consequence the water near the shore becomes diluted and the salinity falls considerably. The sea-water thus becomes capable of holding more oxygen in solution for the respiration of aquatic animals. This lighter and more oxygenated water flowing far out to the sea probably supplies the initial stimulus to the organisms to move towards the shore and then a regular cycle of migrants is set up. Even Bombay-Duck is followed by sharks and other larger fish that feed upon it. Setna (*op. cit.*) has described an ingenious device used by the fishermen of the Bombay coast to protect their catch from the depredation of the larger species.

Our knowledge of the physical conditions of the waters along the western coast is very meagre[1] and I have not been able to find any details of the variation in salinity and temperature during different seasons of the year in this area. However, a perusal of any physical map of India will show that the Gulf of Cambay receives larger volume of water from the Narbada and Tapti Rivers, and that no other big river or stream falls into the sea on the Malabar Coast. There is no doubt that the salinity of the water in the Gulf of Cambay must always be lower than that of the sea and be subject to considerable variation depending on the quantity of water discharged by the rivers at different seasons of the year. It is probable that this diluted sea water affects the salinity as far down as Bombay, but it has also to be remembered that this portion of the western coast receives between 75″ and 100″ of rainfall during June to October, and this is likely to have considerable effect in lowering the salinity of the sea water in the neighbourhood. The accumulative effect of this rainfall will be felt most in September and at this period the salinity is likely to be the lowest. Corresponding with this period of low salinity, we find that Bombay-Duck is most numerous on the Bombay coast in September. This presumption is supported by the popular beliefs of the fishermen of the Bombay Presidency, for instance, 'it is a common belief among fishermen that if there be good rainy season with record floods, the prospects of good sea fishing are assured.' (Sorley, *l.c.*, p. 117.) The rainfall on the Malabar Coast is also heavy, but the rain that falls is drained off by the Godavari, Kistna and Cauvery Rivers, all of which fall into the sea on the east coast (Coromandal Coast). It is thus seen that the dilution of sea water may result from local heavy rainfalls or through the drainage of larger rivers, and it is significant that none of these two factors is operative over the stretch of the coast from below

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[1] Reference may here be made to the work of Matthews (*Trans. Linn. Soc. London*, Zoology (2), xix, pt. i, pp. 169-205, pls. x-xiii, 1926) on the Physical Oceanography of the Percy Sladen Trust Expedition to the Indian Ocean in 1905. Matthews gives charts of the variation in salinity of the surface waters of the Arabian Sea, but does not deal with the coastal waters which are of special significance for studying the movements of Bombay-Duck.

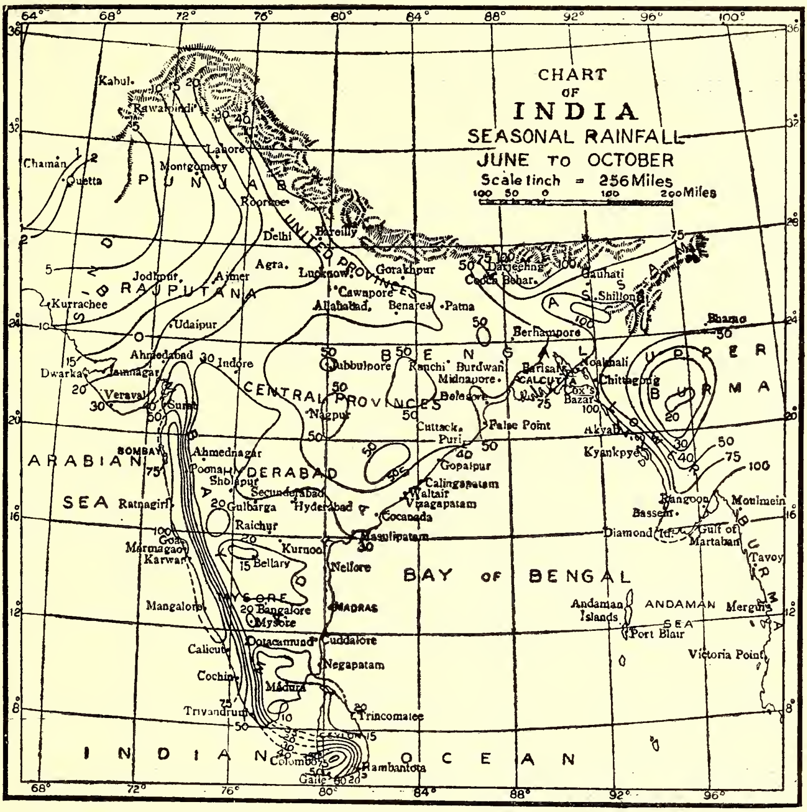
CHART OF INDIA
SEASONAL RAINFALL
JUNE TO OCTOBER
Scale 1inch = 256 Miles
100 50 0 100 200 Miles
64° 68° 72° 76° 80° 84° 88° 92° 96° 100°
36 32 28 24 20 16 12 8
Kabul
Rawalpindi
Chaman
Quetta
Lahore
Montgomery
PUNJAB
Roorkee
Delhi
Bareilly
UNITED PROVINCES
Agra
Lucknow
Gorakhpur
Cawnpore
Allahabad
Benares
Patna
Darjeeling
Cooch Behar
Gauhati
Shillong
ASSAM
Jodhpur
Ajmer
RAJPUTANA
Kurrachee
Udaipur
Ahmedabad
Indore
Dwarka
Jamnagar
Veraval
Surat
CENTRAL PROVINCES
Jubbulpore
Nagpur
Ranchi
Burdwan
Midnapore
Balasore
BENGAL
Berhampore
Barisal
CALCUTTA
Noakhali
Chittagong
Cox's Bazar
Akyab
Bhamo
UPPER BURMA
BOMBAY
ARABIAN SEA
Ahmednagar
Poona
Sholapur
HYDERABAD
Secunderabad
Hyderabad
Gulbarga
Raichur
Ratnagiri
Cuttack
Puri
False Point
Gopalpur
Calingapatam
Waltair
Vizagapatam
Cocanada
Masulipatam
Kyaukpyu
Rangoon
Moulmein
Bassein
Diamond Id.
Gulf of Martaban
Tavoy
Goa
Marmagao
Karwar
Kurnool
Bellary
Nellore
BAY OF BENGAL
MYSORE
Mangalore
Bangalore
Mysore
MADRAS
Ootacamund
Cuddalore
Negapatam
Calicut
Cochin
Madura
Trivandrum
Andaman Islands
ANDAMAN SEA
Port Blair
Mergui
Victoria Point
Trincomalee
CEYLON
Colombo
Galle
Hambantota
INDIAN OCEAN

Fig. 4.—Chart showing seasonal rainfall in India from June to October.

Bombay to Madras and the result is that there is no fishing of the Bombay-Duck in the whole of this area.

As a result of the researches of Dallas[1] and Sewell[2] and his predecessors on the 'Investigator', we are in a much better position with regard to the study of physical factors in the Bay of Bengal. At all times the surface water throughout the Bay of Bengal and the Andaman Sea possesses a low salinity owing to the influx of large volumes of fresh water from the great rivers of India and Burma, and this influx must also to some extent affect the temperature of the surface water. Moreover, the Bay is exposed at different times of the year to such opposite influences as the south-west and north-east monsoons and as most of the larger rivers of India empty themselves into it, one would naturally expect to find that the conditions present in the surface waters would show a considerable range of variation both as regards the salinity of water and its temperature. These variations can be attributed largely to the different seasons of the year. With the changing seasons, the salinity of the surface waters changes considerably, and this can be readily understood by a reference to Sewell's charts, reproduced here in a modified form, of the surface salinity of the

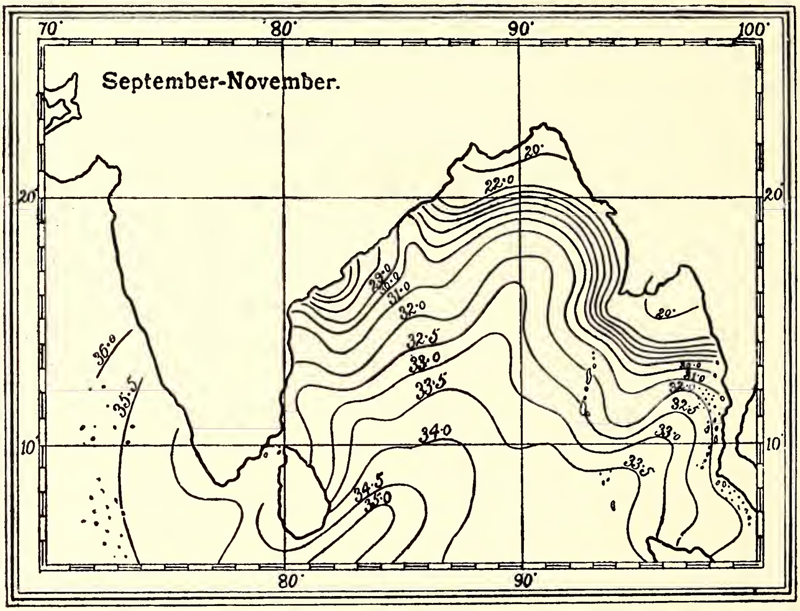

Fig. 5.—Chart showing surface salinity of the Bay of Bengal during the period from September to November (Modified after Sewell).

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[1] Dallas, *Charts of the Bay of Bengal and Adjacent Sea north of Equator, showing the Specific Gravity, Temperature and Currents of the Sea Surface* (Calcuta, 1887).

[2] Sewell, *Mem. As. Soc. Bengal*, ix, pp. 207-356 (1929).

Bay of Bengal during September to November, December to February, March to May and June to August. It has to be borne in mind that owing to the geographical configuration of India, most of the rivers of India open into the Bay of Bengal and in consequence the major portion of the rainfall over not only the Indian

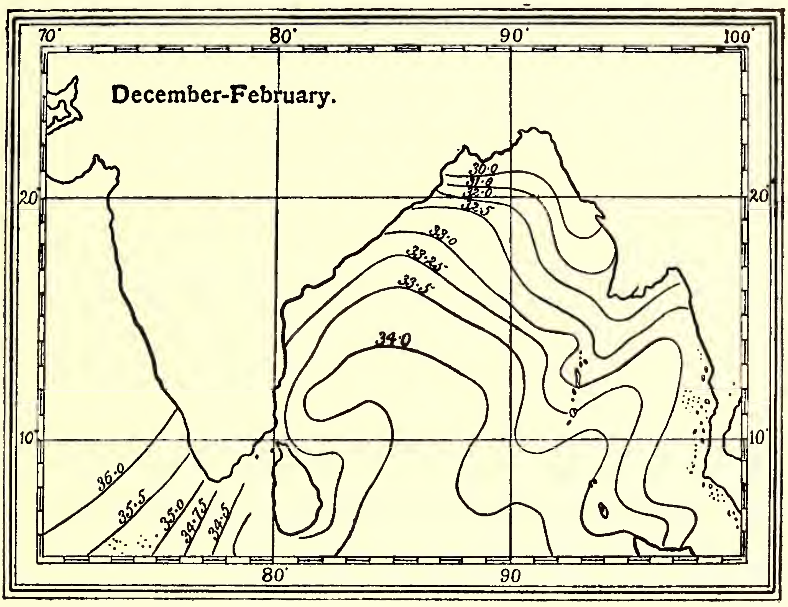

Fig. 6.—Chart showing surface salinity of the Bay of Bengal during the period from December to February (Modified after Sewell).

Peninsula but also the region lying to the north finds its way eventually into the Bay, though this will of necessity take some time, depending on the length of the river. This means that the salinity of the Bay in October will be influenced to a large extent by the rainfall of the preceding south-west monsoon in July and August over United Provinces, Bihar, etc. In this country monsoon forecasts are made use of in connection with agricultural operations, but it is hardly realized that the same forecasts can be made use of in connection with the fisheries. The collective rainfall over India varies from year to year and in any one year the effect of the monsoons may vary very considerably in different parts of India. All these are important considerations in connection with the problems of fisheries in this country.

I have remarked above that the movements of the Bombay-Duck are, in all probability, governed by the stimulus supplied by the low salinity of the sea-water.[1] In this connection the salinity chart of the Bay of Bengal for the quarter September to November is of special significance. This chart shows three definite areas of low salinity, (i) the mouths of the Irrawaddy and Salween Rivers, (ii) the mouths of the Ganges and (iii) the Ganjam coast and the mouths of the Godavari and Kistna Rivers. Whereas the low salinity of the Bay at the mouth of the Ganges and the Irrawaddi may be due to the accumulative effect of the south-west monsoon, on the western side of the Bay considerable lowering of the salinity in September to November at the mouth of Godavari and Kistna may be due to the autumn rains which fall in the peninsula and especially the coast districts. It has been indicated above that these very areas are the chief centres of the fishery for the Bombay-Duck. It is abundantly clear, therefore, both from the seasons of occurrence of the Bombay-Duck near the shores and from the record of the areas where it occurs in abundance, that there is a definite correlation between the low salinity of the water and the occurrence of *Harpodon nehereus*.

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[1] At the head of the Bay the salinity is affected to a depth of at least 50 fathoms.

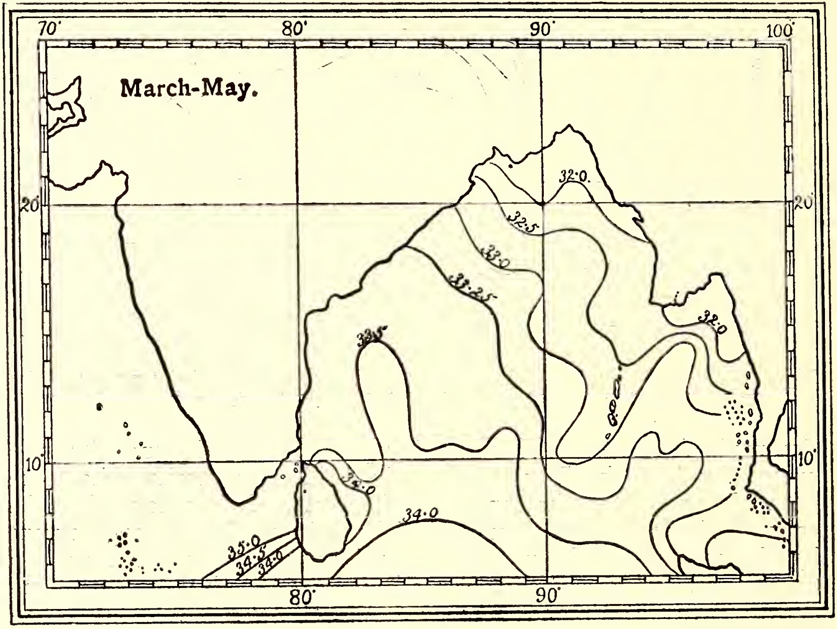

Fig. 7.—Chart showing surface salinity of the Bay of Bengal during the period from March to May (Modified after Sewell).

The low salinity of water is only one of the factors that bring about the mass-movements of the Bombay-Duck. The river-water and rain-water are more highly oxygenated and have a somewhat lower temperature than that of the sea-water. Another possible factor, especially in the estuarine areas, is the great increase in the available food supply. The flow of the rivers brings down with it great quantity of valuable vegetable debris and detritus. This serves as a source of food for small animals on which larger animals prey. Large quantities of nutrient salts, derived from the land, are poured into the sea and this results in a very large increase in the diatom flora, that in turn serves as a food supply for the smaller marine organisms. Probably it is a combination of these and other factors that induce Bombay-Duck to visit our shores. The nature of the bottom does not seem to effect these movements, for near Bombay the sea bottom consists of sandy banks, while in the Bay of Bengal the sea bottom consists of brown mud in the chief centres of the fishery. As regards the salinity and temperature of deeper waters very little is known.

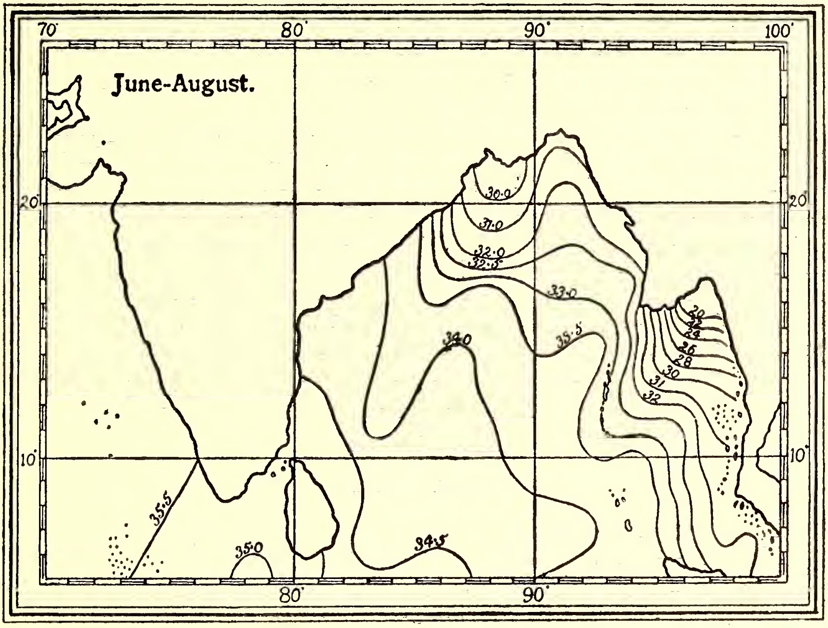

Fig. 8.—Chart showing surface salinity of the Bay of Bengal during the period from June to August (Modified after Sewell).

Judging by the above criterion, there are two areas along the coast of India where Bombay-Duck should be plentiful, but, so far as I am aware, it is not found there. These two areas are the Chilka Lake along the Ganjam Coast and the Delta of the Indus. In both the localities the salinity is very low at times on account of fresh water brought down by rivers, etc. It seems likely that the food-species of the Bombay-Duck do not occur in these areas, and as the movements of the fish are for feeding purposes, its absence in these localities can be explained on this assumption. This is merely a tentative suggestion as the subject has never been investigated so far.

It has been noted above that *Harpodon nehereus* is found in the estuaries of the Irrawaddi, the Ganges, the Godavari and the Kistna Rivers throughout the year, and that young specimens have been collected by several workers from such regions. It seems likely that the low salinity and other physical and biological factors of the estuarine waters suit the Bombay-Duck or the species of fish and shrimps on which it preys. In the Ganges, the fish is stated to ascend as high up as Diamond Harbour where on the 5th of March, 1933, I found the salinity to vary from 7.90 per mille (midstream, tide flooding) to 8.50 per mille (near shore, last phase of ebb tide). In the rainy season, the salinity falls considerably lower. It would thus seem probable that Bombay-Duck ascends and descends in the estuarine region with the rise and fall of the salinity at different seasons of the year and that the fish or its food-species does not live below a certain range of salinity. The observations of the fishermen of Port Canning support this view.

Some of the possible factors, such as low-salinity, temperature, movements of food-species, oxygenated water, water rich in food-material etc., that may be responsible for the mass-movements of *H. nehereus* are indicated above from the meagre data available so far, but it should be clearly understood that the problem has not been investigated in detail anywhere in India in connection with any species of fish. It is clear, however, that there is a great scope to increase the yield of this fishery and to put it on a permanent basis provided the exploitation of the fishery is undertaken along well recognised scientific principles. The fish is easily cured by drying and in this condition it is known as Bombay-Duck and is greatly relished with curry.

LOCAL NAMES.

Bombay:—*Bummalo*.

Madras:—*Cucah sawahri; Cocomottah* (Tel.); *Vangaravasi* at Madras; and *Vanamottalu* on the East Coast.

Bengal:—*Nehare* in the Gangetic Delta; *Lotya* at Chittagong and *Lotia* or *Lotya* at Noakhali and Bakarganj.

Burma:—*Baraga*.

Malay:—*Luli* and *Aruan-tassik*.

When fresh the fish is familiar to Europeans as *Bummalo* and when dried as Bombay-Duck.

ACKNOWLEDGMENTS.

I have to express my sincerest thanks to Lt.-Col. R. B. S. Sewell and to Dr. Baini Prashad for going through the manuscript and for making valuable suggestions. Babu R. Bagchi has made all the figures, except figure 4, for this article with his usual skill and care and I am thankful to him for this. Dr. B. Chopra has identified the crustaceans for me and Mr. Dev Dev Mukerji has helped me in various ways. I am greatly indebted to them for their kindness.

ALIMENTARY CANALS OF FOOD FISHES.

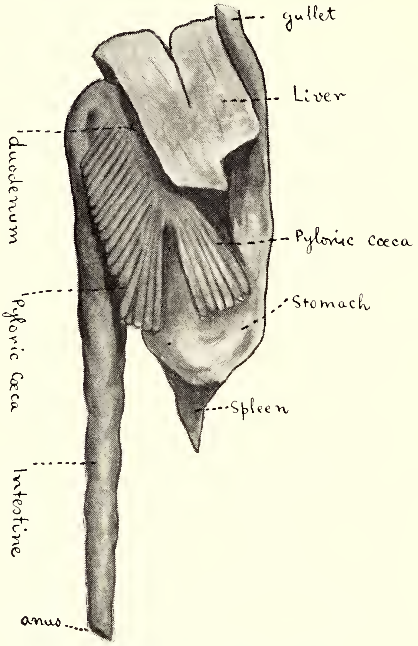
gullet
Liver
duodenum
Pyloric cœca
Stomach
Pyloric cœca
Spleen
Intestine
anus

Fig. 1.—*Salmo fario*
Brown Trout.

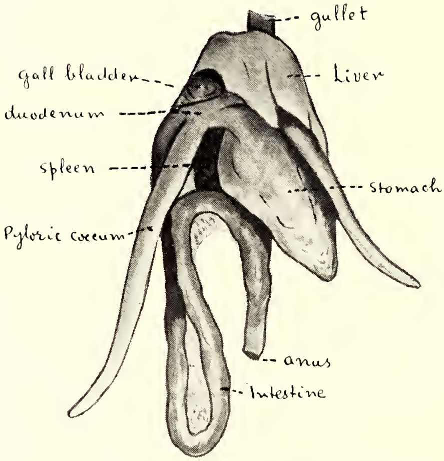
gullet
gall bladder
Liver
duodenum
spleen
Stomach
Pyloric coecum
anus
Intestine

Fig. 2.—*Ophiocephalus marulius.*
Vern. *Saul.*

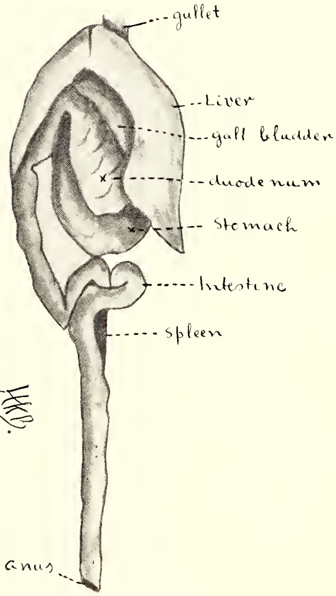
gullet
Liver
gall bladder
duodenum
Stomach
Intestine
spleen
anus

Fig. 3.—*Wallago attu.*
Vern. *Mullee.*

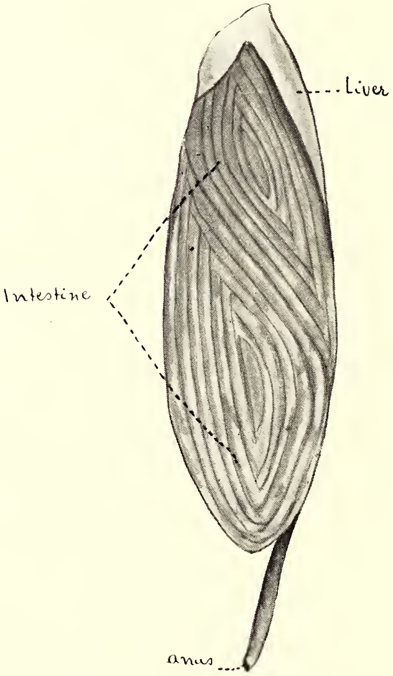
Liver
Intestine
anus

Fig. 4.—*Cirrhina mrigala.*
Vern. *Mori.*

HABITS AND HABITATS OF FOOD FISHES OF THE PUNJAB.

BY

M. HAMID KHAN, M.SC., LL.B.,

Fisheries Research Officer, Punjab.

(*With one plate*).

Most of the inhabitants of the Province, especially those residing in the hills and in the riverian districts have no scruples to eating fish. There are others who, on religious grounds, do not kill and eat them. Some, however, object to certain kinds of fish which they consider repulsive, while others, though not averse to eating fish, object to them being captured in certain sacred places. Such sacred places are protected under the Fisheries Regulations as *Sanctuaries*[1] and some of these form the best natural spawning grounds of many of the local species and are situated in Kangra, Hoshiarpur, Hissar, Amballa and Jhelum Districts.

Fishes, like other main divisions of the animal kingdom, may conveniently be divided into two groups namely:—

(1) Herbivorous or vegetarian and (2) Carnivorous.

In the first group are included those fishes which live mostly on weeds and other aquatic vegetation such are the *Cyprinidae* (Carps). These fishes are devoid of teeth in their jaws and like all other herbivorous animals, possess a long alimentary canal. They are wholesome and well-flavoured and are consumed in large numbers and without any scruples.

The second group includes those fishes which thrive mostly on animal diet, such as insects, molluscs or other fishes, and also feed on dead bodies. They all possess teeth in their jaws and have a straight alimentary canal. This group may be further sub-divided into *firstly*:—those carnivorous fishes which are voracious, predaceous and consume offal and carcases, such are the *Siluridae* or Cat fishes. Being scaleless, they are forbidden to Jews and Shia Mohammadans. The Jews[2] are only permitted to eat 'Whatsoever hath fins and scales in the waters, in the seas and rivers', and this law is strictly observed by Shia Mohammadans as well. They are not considered very wholesome. *Secondly*:—those carnivorous fishes which live mostly on insects and their larvae, molluscs, crustaceans and other fishes, such are the *Salmonidae*, *Ophiocephalidae,* and others. They are wholesome and are considered excellent eating.

The difference in the alimentary canal of the carnivorous and vegetarian fishes is remarkable. In *Salmo fario* (Brown Trout, fig. 1), the short gullet leads into a U-shaped stomach, and the intestine after the duodenum becomes bent upon itself and then passes backwards without any convolution. There are forty-six blind glandular tubes, the pyloric caeca, which open into the duodenum. In *Ophiocephalus marulius* (Murrel: fig. 2), the short gullet opens into a bag-like stomach, which is capable of accommodating prey of any length. In a 14'' Murrel, with a normal stomach of 1'', a *Botia* of 2·7'' was found extending from the gullet to the posterior extremity of the stomach. The intestine, after the duodenum, becomes bent upon itself and then passes backwards, without any convolution, to the anus. Two pyloric caeca open into the duodenum. In *Wallago attu* (*Vern. Mullett*, fig. 3), the short gullet opens into a wide stomach, capable of being stretched to a considerable extent. The intestine after the duodenum, becomes bent upon itself and then with one convolution passes backwards to the anus. In *Cyprinidae*, e.g., *Cirrhina mrigala* (*Vern. Mori*, fig. 4), the gullet passes into a long tubular stomach, and the intestine is convoluted like a watch spring. The intestine, if fully extended, measures many feet in length.

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[1] Hamid Khan, *The Punjab Fisheries Manual*, 1930, p. 12.

[2] Day, F., *Ind. Med. Gaz.*, Vol. vi, 1871, pp. 5-8 and 26-29.

The Punjab with all its rivers, canals and jhils is essentially a fish producing tract of country. Its fisheries extend from the junction of the five rivers to almost every place where water exists in any quantity even high up in the hills. Important fishing waters[1] in the Province are the following:—

1. The Indus River and its tributaries, such as Chel, Haro, Reshi, Soan, Chablat, Saggar, Nandra, Shakardara Fatehjung Sil, Wadala and Pindigheb Sil, Sohan, Kurang, Leh and Ling in Attock and Rawalpindi Districts. These are mostly Mahseer waters.
2. The Jhelum River with its tributaries, and canals with their heads at Mangla, and Rasul. Tangrot, the famous Mahseer sporting resort is on the River Jhelum in Kashmir State territory.
3. The Chenab River and its tributaries, such as Nalas, Palkhu, Dhan, Sabskot, Gadgor, Lunda, Tawi, Bhimber, Bhandar, etc., and its canals with their Heads at Marala and Khanki.
4. The Ravi River and its tributaries such as Basantar, Aik, Deg, Bhed, Sakki, Naumani, Naluha, Ujh, etc., and its canals with their Heads at Madhopur, Balloki and Sidhnai.
5. The Beas River and its tributaries, the 'Trout Waters' in Kulu such as Sarbarri, Sainj, Tirthan, Parbatti, Chhaki, Fojal, Nashal, and Uhl streams; and Mahseer streams of Kangra Valley e.g. Binnun Khad, Gaj stream, Baner Khad and Chaki Nala.
6. The Sutlej River and its tributaries such as Karnali Gad, Kajo Gad and Kurpan River, Buddha Nala, and its canals with their Heads at Ropar, Ferozepore, Suleimanki and Panjnad.
7. Ghaggar, Jaiya, Markanda, Tangari, Sarusti and their tributaries in Ambala and Hissar Districts.
8. Right Bank of the Jumna River near Tajewala weir and its tributary Somb Nala, near Dadhupur; and the Western Jumna Canal near Dadhupur Regulator, which lie in the Punjab.

Fisheries in the Districts of Montgomery, Multan, Muzaffargarh, Jhang, Lyallpur, Mianwali, Shahpur and Sheikhupura are leased annually, while in all the other districts yearly individual licenses are issued for nets as well as for rod and line.

A fairly large collection of the food fishes of the Province has been made and observations on their habits and habitats have been recorded from various streams. Arranged according to their relative economic value the food fishes[2] of the Province may be included in the following families:—

1. *Cyprinidae* (Carps).
2. *Siluridae* (Cat-fishes).
3. *Ophiocephalidae* (Murrel).
4. *Salmonidae* (Trout).
5. *Notopteridae.*
6. *Rhynchobdellidae* (Spiny Eels).

The classification followed in this paper is that of Dr. Day, but the nomenclature of the fishes has been corrected according to the recent researches, and synonyms are given where necessary. Local names of the fishes, given here, vary in different localities.

FAMILY: CYPRINIDAE.

Cyprinidae or Carps with scales on their bodies, one dorsal fin and without teeth in their jaws, are well-represented in all the rivers of the Punjab. They have wholesome, well-flavoured flesh, though bony, and are considered excellent food. Arranged according to their relative economic value the following genera represent the food fishes of the Province:—

1. *Labeo* (Cuvier).
2. *Barbus* (Cuvier and Valenciennes).

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[1] Hamid Khan, *The Punjab Fisheries Manual,* 1930.

[2] Coloured illustrations of some of these fishes appear in *Journ. Bomb. Nat. Hist. Soc.*, vol. xxxvi (1932), pp. 29-66, 'Game Fishes of Bombay' by Sir Reginald Spence and S. H. Prater.

3. *Cirrhina* (Cuvier and Valenciennes).
4. *Catla* (Cuvier and Valenciennes).
5. *Aspidoparia* (Heckel), Bleeker.
6. *Barilius* (Ham. Buch.).
7. *Chela* (Ham. Buch.).
8. *Orelnus* (McClelland).
9. *Garra* (Ham. Buch.).
10. *Scaphiodon* (Heckel).

GENUS: LABEO.

Labeo rohita (*Vern. Pohu, Tapra, Dhambra*) occurs in all the rivers, streams and dhans of the Province in the plains and never goes up to the hills. It feeds on weeds and vegetation, and takes a bait of wheat flour mixed with spices. It is a very active fish. It is often seen jumping clean over the nets of fishermen with considerable force and velocity. It breeds during the monsoon, in July and August, and is a prolific breeder. A ripe female of 10 lbs. contained 1,905,000 ripe eggs. The egg measures 1·5 mm. and is non-floating. It swells to 3 or 4 times its size by the absorption of water by the vitelline membrane and hatches out in less than 30 hours. During the rainy season as soon as the streams are flooded, these fishes run up to shallow waters to spawn, and after laying their eggs they fall back into dhans or jhils or side streams, which, after the floods, are cut off from the main channel. From these dhans these fishes are caught in nets in large numbers.

It grows to 3′ or more in length, and is one of the best edible fish of the Province. Its flesh is wholesome and well-flavoured. It is good for stocking tanks. Common in the market.

Labeo gonius Ham. Buch. (*Vern. Seereha*), is another Carp of the plains, common in Sutlej and Beas rivers. It breeds during July and August, and is a prolific breeder. The egg measures 1·5 mm., is non-floating and swells to 3 times its size as soon as it sinks. It hatches out within 24 hours in a temperature ranging from 78°F. to 82°F. It grows to 2′ or more in length and is considered excellent food. It is good for stocking tanks. Common in the market.

Labeo calbasu Ham. Buch. (*Vern. Dhai, Kalahan, Kalbons, Di*), occurs in the plains only and is readily recognised by its blackish colouration. It spawns during July and August and is a prolific breeder. A ripe female, weighing 4 lbs., contained 739,400 eggs. It attains 2′ or more in length and is good eating. Common in the market.

Labeo diplostomus Heckel (*Vern. Gid*), occurs in the submontane streams, but never goes up to snow-fed streams, and is found in Mahseer waters of Kangra, Gurdaspur, Rawalpindi and Jhelum Districts. It breeds during the monsoon. It grows to 1′ or more in length and possesses wholesome but bony flesh; eaten by the local inhabitants.

Labeo microphthalmus Day (*Vern. Bhangan*), occurs in the plains as well as in the submontane streams. Its snout is smooth without any groove. It breeds in the rains, during July and August, is a prolific breeder. A single ripe female contained 6,105 eggs per lb. of its weight. It has bred successfully in the tanks and its fry often move in shoals. It grows to 18″ or more in length, is good eating but bony, and is consumed locally.

Labeo sindensis Day (*Vern. Gheri, Gher*) is another hill Carp, but comes down in the canals and is often caught in the plains. It is silvery in colour with a reddish tinge, and reddish fins. It grows to over 1′ in length, is good eating but bony. Consumed locally.

Labeo dyochilus McClell. (*Vern. Butal, Paratha, Dhai, Torki, Kunni*), also belongs to submontane streams and is often found in tanks fed by canals. It breeds during the rains, in July and August. It grows to 2′ or more in length, is considered excellent as food, and is eaten by the local inhabitants.

Labeo nigripinnis Day (*Vern. Kali* or *Bagi Machhi*), is found in Mahseer waters and is common in Attock, Rawalpindi and Jhelum Districts. It grows to over a foot in length and is eaten by the local inhabitants.

GENUS : BARBUS.

Barbus tor Ham. Buch. (*Vern. Mahsir, Bhor, Chiniaru, Chitratu, Machh, Ghaur, Khakhiaru*) represents the Mahseer of sportsmen, and includes many different varieties in the Punjab. A collection is being made from different localities to ascertain their chief characteristics. The Mahseer occurs in all the hill tracts of the Punjab, but is not met with in snow fed streams where the temperature falls below 60°F. in summer. In the Beas it goes up to Mandi State, but so far has not been recorded from Kulu. Sanctuaries in Kangra are its favourite resorts and it frequently breeds there. During winter it travels down as far as Multan and Mozaffargarh, but as soon as the water gets warmer, it begins to ascend the hill streams.

Its sex organs and fry are being collected from various streams to study its breeding season. Fry of all sizes are found in abundance in the hill streams of Kangra, Gurdaspur, Rawalpindi, Attock, Jhelum and Hoshiarpur Districts; River Beas near Dera Gopipur (Kangra District); Ravi near Muktesar and Madhopur; River Chenab above Marala Head; River Jhelum above Rasul Head and at Tangrot; Chablat, Sohan and Kurang streams in Attock and Rawalpindi Districts are the best fishing streams and localities for Mahseer.

Barbus tor feeds on insects and aquatic vegetation. It takes artificial fly and spoon and likes wheat flour as well. In ponds and tanks attached to sacred places, they become easily domesticated and are fed on wheat flour. It is a very active fish and can leap over obstacles. It grows to 3′ or more in length and is said to reach 200 lbs. in weight.

Barbus hexastichus McClell. (*Vern. Lubar, Chitratu*, and *Barbus chilinoides* McClell. (*Vern. Chitratu*), resemble *Barbus tor* in general habits and are found in Mahseer waters. They have been caught from the River Ravi near Muktesar and from Kangra streams. They attain 2 or 3 feet in length, are considered excellent food, and are consumed locally.

Barbus sarana Ham. Buch. (*Vern. Kharni, Khangni, Kangrota, Karati*; 'Olive Carp') occurs in all the rivers and streams in the plains as well as in submontane streams. It is a prolific breeder and lays its spawn in shallow waters during the monsoon, in July and August. Ripe females have been easily stripped. The hatching takes place within 20 hours in water where the temperature ranges from 78°F. to 82°F. It grows to about a foot in length. It is good eating, but bony.

GENUS : CATLA.

Catla catla[1] Ham. Buch. (*Vern. Theila, Theil*) occurs in all the rivers and streams in the plains. It is a prolific breeder. A ripe female weighing about 10½ lbs. contained 400,275 ripe eggs. It spawns during the monsoon, in July and August, and its fry have often been found in shallow pits left after the floods have subsided. 'It is a very strong and active animal, and often leaps over the nets of fishermen with great force and velocity.'[2] It grows to 3 feet or more in length and has a very wide girth, hence the local name *Theila, Theil* (i.e. like a bag). It possesses rich, sweet and well-flavoured flesh and is not bony. 'The head is very fat and delicious and the flavour of the whole is excellent when the size is moderate . . . but when large it acquires a rank taste.'[3]

GENUS : CIRRHINA.

Cirrhina mrigala Ham. Buch. (*Vern. Mori, Morakha, Naraini, Mirgal*) occurs in all the rivers, streams and canals in the Punjab. It is a vegetable feeder, but has no objection to taking a bait of worms. It is a prolific breeder, and a ripe female weighing about 3¼ lb. contained 216,800 eggs. It spawns during the rains, in July and August. As soon as the streams, rivers and tanks are flooded by the first monsoon flood, the fish run up the shallow water in flooded fields and side streams, females followed by males, play together, come in contact with each other, and the female lays its eggs while the male pours its milt at the same time. Very often the fishes have been heard to make a guttural sound, as if calling their mates. Since there is an immense waste of eggs and fry, Nature has provided these fishes with an enormous power of reproduction. The egg measures 1·5 mm., is non-floating and swells to 3 or 4 times its size as soon as it sinks. The hatching takes place within 24 hours in temperature ranging from 78°F. to 82°F. It breeds successfully in tanks and ponds if they are flooded during the rains. It grows from 8 to 10 inches in its first year, and reaches 14 inches in the second, becoming mature in its third year. It grows to 3 feet or more in length and is one of the commonest and the cheapest carp in the Province. It possesses white, well-flavoured flesh and is considered excellent eating.

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[1] S. Raj, *Rec. Ind. Mus.*, vol. xii, 1916, p. 254.

[2] Ham. Buch., *Fish., Ganges*, 1822, p. 287.

[3] Hamid Khan, *Journ., Bomb. Nat. Hist. Soc.*, xxix, 1924, p. 258.

Cirrhina reba Ham. Buch. (*Vern. Sunni*), is a smaller representative of the genus. It is common in all the rivers and streams and breeds during the monsoon. It is a prolific breeder, and a half-a-pound female contained 3,200 eggs. It attains a foot in length. It is eaten by the local inhabitants but is bony.

GENUS: CROSSOCHILUS.

1889. *Cirrhina latia* Day, *Faun. Br. Ind. Fish*, p. 279.

Crossochilus latia[1] Ham. Buch. (*Vern. Taler, Golu, Dogru, Mura*) is common in all the hill streams of the Punjab and is found sticking to stones like a loach. It grows to hardly 8″ in length and is often caught in Kangra by means of *Kalerni*[2], a horse-hair noose. It is eaten by the local inhabitants.

GENUS: ASPIDOPARIA.

Aspidoparia morar Ham. Buch. (*Vern. Chilwa, Chal, Reta, Gachal*) or chilwa of the Punjab, occurs in almost all the rivers and is often seen jumping out of water in large numbers just below the canal weirs. It is migratory in its habits and runs up in shoals in March in search of its breeding grounds, and descends in October after spawning. In the Beas River, near Gurdaspur, where it is known as *Reta* or *Gachal*, it is caught in March and October by diversion of the water. When chilwa are running up stream in shoals, the fishermen select side stream and stop it both up and down stream during the night. A screen made of reeds, known as *chipli*, which allows the water to run through, but stops the fish, is placed in the lower bund. The water is then diverted into a new channel just before dawn. The water between the bunds is drained off and the stranded fish are collected in large quantities.

Aspidoparia morar breeds in April and May. A female caught on 31st March contained fully ripe eggs. It reaches 6 or 7 inches in length and is used as bait. Its bones are soft and it is fried whole. Its flesh is rich, wholesome and well-flavoured and it is said to possess nourishing and invigorating qualities. It is consumed locally.

GENUS: BARILIUS.

Barilius vagra Ham. Buch. (*Vern. Chilwa, Chal, Lohari*) occurs in the hills as well as in the plains and is also called *Chilwa*. It is migratory in habit and has been caught in all the rivers and canals. It attains 5″ or more in length. It is very rarely caught by the fishermen, as the regulated mesh of their nets is 1½ inches square or 6 inches all round and such small fishes escape through it. It is good eating.

Barilius bendelisis Ham. Buch. (*Vern. Chilwa, Chal*) resembles *B. vagra* in its habits and attains 6 inches or more in length. It is good eating.

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[1] Vinciguerra, *Amer. Mus. Stor. Nat. Genova*, xxix, p. 246, pl. vii, fig. 4, and Hora, *Rec. Ind. Mus.*, xxii, p. 183.

[2] Hora, S. L., *Journ., Proc. As. Soc. Beng.* (*New series*), Vol. xxii, 1926, No. 1, pp. 81-84.

GENUS: CHELA.

Chela gora Ham. Buch. (*Vern. Chilwa, Chal*) is another Chilwa of the Punjab. It possesses a long, flat, silvery body, with cutting abdomen, upturned mouth and concave lateral line. It occurs in all the streams and is very often near the canal weirs. It moves in shoals and is migratory. It attains 9 or 10 inches in length, is used as bait and is good eating when fried. It is seldom caught by the fishermen as it passes through the mesh of their nets. It rises to fly.

Chela bacaila Ham. Buch. (also *Chilwa*, *Chal* or *Parranda*) occurs in all the streams. It reaches 7'' or more in length, and is used as a bait. It is good eating.

GENUS: OREINUS.

Orienus sinuatus[1] Heckel. (*Vern. Gulguli, Saloh, Galda, Slaon*) or Himalayan barbel is one of the hill carps possessing very minute scales. It is the only indigenous fish that occurs in the Kulu Valley and is found in the Beas River as far down as Mirthal where the hills end. Further down in the plains no one knows it. During winter in Kulu, it is not found in waters eblow 50°F. In the Ravi River it comes up to Madhopur and very often goes down the canal as far as Dhariwal. Its mouth is inferior and the lower lip is well-developed and forms an adhesive sucker to enable the fish to adhere to rocks and live in rapid hill streams. Ripe females have been caught from April to October, which is its breeding period, and fry seen with yolk sac from April to December. In the last week of April newly hatched alevins have been found in a spring in Kulu, and in November a ripe male has been caught. In August a ripe female caught in Fojal Nal in Kulu in temperature 60° F. yielded eggs quite easily. Eggs measure 2 mm. or 11 to the inch, and when left in water they swell to the size of 5 mm. A 2½ lbs. female, 17″ in length contained about 15,000 eggs.

Orienus sinuatus creeps over stones, eating the green vegetation which covers them and also the small cadis larvae which are attached to them. It takes a worm in clean water, and is said to like mulberries. It grows to at least 2′ in length. It is good eating, but bony. 'It is too rich for some people, but does not deleteriously affect those used to it.

GENUS: GARRA.

1919. *Discognathus jerdoni* Var. *kangrae* Annandale, *Rec. Ind. Mus.* xviii, p. 74. *Garra gotyla*[2] Gray (*Vern. Kurka, Dhogun*) is a hill carp and occurs in abundance in the Kangra hill streams. It possesses a suctorial disc on the chin, formed on the lip, which enables it to adhere to rocks. It attains at least 8″ in length and is often caught by a horse-hair noose (*Kalerni*) in Kangra. It is eaten by the local inhabitants.

1872. *Discognathus lamta* Day, *Journ. As. Soc. Beng.* xli (2), p. 318.

Garra monti-salsi[3] Hora, occurs in the streams of the Salt Range, Punjab, and has been collected from Choa Saidan Shah streams. It is eaten by the local inhabitants.

GENUS: SCAPHIODON.

Scaphiodon readingi[4] Hora, occurs in the Salt Range streams and is common in Choa Saidan Shah. In the adult, the colour is dark-grey above, yellowish underneath. The young ones are golden yellow in colour with indistinct dark bands on the dorsal surface. In many specimens, the snout, anal fin, and posterior sides of the body are covered with a regular series of tubercles which are of parasitic origin.[5] Ripe males and females have been caught in April and June. It reaches at least 1′ in length and is eaten by the local inhabitants.

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[1] Day, F., *Faun. Br. Ind. Fish*, i, p. 249.
[2] Hora, S. L., *Rec. Ind. Mus.*, xxii, 1921, p. 653.
[3] Hora, S. L., *Rec. Ind. Mus.*, xxv, p. 378.
[4] Hora, S. L., *Rec. Ind. Mus.*, xxv, p. 397, pl. viii.
[5] Prashad, *Rec. Ind. Mus.*, xviii, p. 160 (1920).

FAMILY: SILURIDAE.

Siluridae in the Punjab are all scaleless and are known as Cat-fishes. They have one to four pairs of barbels. They prefer muddy to clean waters, and are all carnivorous, having teeth in their jaws and palate. They also possess strong dorsal and pectoral spines, which are usually serrated or toothed, and often cause poisonous or irritating wounds if handled carelessly. *Siluridae* of the hills are small in size and often possess an adhesive apparatus on throat and chest to enable them to adhere to rocks.

Siluridae in general are not considered 'to be very wholesome,[1] either being too rich or too hard and indigestible, whilst their flavour is inspid.' The small branched intermuscular bones present in *Cyprinidae,* are absent in *Siluridae.* They are common in all the rivers and streams of the Punjab, and some of the species in the plains reach a large size. On account of their cheapness they are much in demand by the local inhabitants. Arranged according to their relative economic importance they include the following edible genera:—

1. *Rita* (Bleeker).
2. *Wallago* (Bleeker).
3. *Ooria* (Jordan).[2]
4. *Pseudeutropius* (Bleeker).
5. *Eutropiicthys* (Bleeker).
6. *Callichrous* (Ham. Buch.).
7. *Silundia* (Cuv. & Valen.).
8. *Blyptothorax* (Blyth).[3]
9. *Saccobranchus* (Cuv. & Valenc.).
10. *Sisor* (Ham. Buch.).

GENUS: RITA.

1889. *Rita buchanani* Day, *Faun. Br. Ind. Fish*, i, p. 165.

Rita rita Ham. Buch. (*Vern. Khakka, Trikunda*) occurs in all the rivers and streams. It has three strong spines and is thus locally known as *trikunda* (three-spined). It is very tenacious of life and can be carried alive to long distances wrapped in a moist cloth. It makes a quaking or grating sound by the movements of its strong pectoral spines in their sockets, while a guttural sound is produced if the ventral surface of the living fish is pressed. This is due to the air in the air-bladder being pressed out through the mouth and gill clefts. This can be verified if the fish is put under water and its ventral surface pressed, air bubbles issue from the mouth and from underneath the operculum. They prefer muddy to clear water and possess six long barbels, which they employ in moving about, and consequently have less use for their eyes, which are comparatively very small in the adult. One specimen, caught from River Ravi, near Lahore, was healthy in all respects but totally blind. During winter they conceal their heads in crevices of stones or fallen trees and are often caught by divers, who catch them firmly between their three spines and do not permit them to move. When annoyed they raise their spines and often inflict ugly wounds.

Rita rita is carnivorous and feeds mostly on insects, their larvae and on young fishes. It also feeds even on carrion. It takes live bait, worms, chilwa or raw meat. Ripe females have been caught in June and July and successfully stripped. Many males caught from the River Jhelum (temperature 62°F. to 68°F.) were spent up in June. Testes are branched, comb-like, and are full of milt. During the breeding season which lasts from June to the end of July, it migrates to colder waters and moves in shoals. It is a prolific breeder, a ripe female weighing 1 lb. contained 3,000 eggs.

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[1] Day, F., *Rept. Fish and Fisheries, Fresh Water, Ind.* 1871, p. 47.

[2] Jordan, D. S., *Genera of Fishes*, iv, p. 567 (1919).

[3] Blyth, *Journ., As. Soc. Beng.*, xxix, 1860, pp. 153, 155, and Hora, *Rec. Ind. Mus.,* xxiv, 1922, p. 33.

It attains 3′ or more in length, though the specimens commonly obtained are 1-2′ in length. It is very common in the River Ravi and its tributaries. The flesh is rich and firm and its soup is said to possess nourishing and invigorating qualities. It is to be avoided in places where it is a foul feeder.

Genus: Wallago.

Wallago attu Blotch & Schneid. (*Vern. Mulee*) is one of the so-called 'Fresh-water Sharks' of the Punjab. It has an elongate body, deeply cleft mouth, extending behind the eyes, and formidable rows of teeth in the jaws and vomer, and bites viciously if handled carelessly. It inhabits both fast and sluggish waters, and is common in all the rivers and tanks. It is not only carnivorous, feeding on fishes, their eggs and fry, but a voracious and foul feeder devouring carcasses. It is considered to be one of the scavengers of the rivers and feeds both during day and night. Just below the canal weirs, where chilwa abound it may be seen chasing them all day long. Near Ropar (River Sutlej) a family of professional fishermen gave up their profession as they found in the stomach of a *Mulee* the arm of a child, which they recognised by the gold bangle on it to be the arm of their own child, the body of which they had thrown in the river the previous day. Seshachar and Das[1] record a nearly fully grown mud snake, *Cerberus rhynchops*, inside the stomach of a 22-22·75″ long *Wallago attu*, obtained from Caluctta market. The snake measured 25″ in length and 1.5″ in girth.

The spawning season of *Wallago attu* lasts from July to August. As soon as the streams or tanks are flooded by rains, they run up the shallow waters and lay their spawn. Ripe females are easily stripped. Eggs are yellowish in colour and each measures 1.5 mm. As soon as they sink in water they swell to double their size. Embryo differentiates in less than 12 hours and hatches out in from 14 to 24 hours, depending upon the temperature of the water. A newly hatched embryo possesses a long yolk sac, and shows lobular projections at the antero-ventral end of the head, which grow to form the barbels. The yolk sac is soon absorbed and the fry wander about, attack each other and begin to prey upon the eggs and fry of other fishes.

Wallago attu grows to 6 feet or more in length. It thrives in tanks but its culture is to be avoided on account of its carnivorous habits. It takes live bait, worms, chilwa or raw meat. Its flesh is not well-flavoured but on account of its cheapness and the absence of tiny bones, it is very much in demand in the Province and is eaten cooked or fried.

Genus: Aoria.

1889. *Macrones seenghala* Day, *Faun. Br. Ind.* i, p. 150.

Aoria seenghala Sykes. (*Vern. Chaija, Singoa, Singharee, Seengala*) occurs in all the streams and rivers and flourishes in tanks as well. Its maxillary barbels extend to the middle or just beyond the hind margin of the dorsal fin, while in *Aoria aor* (Ham. Buch.) they are much longer and reach the base of the caudal fin. It breeds during June and July. Ripe females have been caught in June. It is carnivorous and feeds on eggs and fry of other fishes. It grows to 3 feet or more in length, while *Aoria aor* is said to attain 6 feet in length. Its flesh is firm and sweet, but decomposes rapidly if kept long without being salted. Considered excellent food. Common in the market.

Aoria cavasius Ham. Buch. (*Vern. Tingara*), and *Aoria tengara*, Ham. Buch. (*Vern. Kingar* or *Tingara*) are smaller varieties. The former[2] is said to attain 18″ though the specimens caught measure 6 to 8 inches, and the latter 4 or 5″ in length. They are common in submontane streams and are eaten by the local inhabitants. In a specimen of *Aoria tengara*, caught in the River Ravi near Madhopur, the maxillary barbels reach beyond the anal fin and the adipose fin commences immediately behind the first dorsal.

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[1] B. R. Seshachar and B. K. Das, *Proc. 18th Indian Sc. Cong.* 1931, p. 229.

[2] Day, F., *Faun. Br. Ind. Fish,* i, pp. 155-156.

GENUS: PSEUDEUTROPIUS.

Pseudeutropius garua Ham. Buch. (*Vern. Bachwa, Dhuan, Dhunga, Baikiri, Karad*) or Bachwa occurs in all the rivers of the Province. It is migratory in habits, and its movements have now become restricted owing to the erection of the canal weirs. Only a few years ago numerous *Bachwa* could be seen in the River Jhelum just below the Rasul Head Works, but now their number is considerably reduced. It is common in the River Jhelum above Rasul Head and in the River Sutlej near Ferozepur and Ropar. It is caught on long line or rod and line from March till the end of October. Ripe males and females have been caught from June till the beginning of August. Mature females can easily be stripped. The testes, comb-like and swollen with milt yield their contents with slight pressure. During the breeding season from March, they ascend the cold waters to spawn in a temperature ranging from 62°F. to 68°F. in the River Jhelum. They move in shoals and lay their eggs in shallow parts of the main stream. It is at this time that they are caught and killed in large numbers. *Bachwa* are carnivorous and feed on insects and their larvae, crustaceans and small fishes. In clear waters they take a fly or a small spoon and in muddy and flooded waters, especially from May to August, worms, pieces of raw liver or clotted blood from an excellent bait. Dorsal and pectoral spines often cause severe wounds if handled carelessly. It grows to 2′ or more in length. The adipose fin is absent in the adult. One of the best food fishes of the Province. Possesses wholesome and well-flavoured flesh and is without any intramuscular bones. *Bachwa* is common in the markets of Ferozepore and Jhelum in the months of March to August.

Pseudeutropius murius Ham. Buch. (*Vern. Pahari, Bachwa, Gulgul, Karad*) possesses an adipose fin throughout its life. There are 8 barbels and their length is generally variable and differs from that given by Day.[1] The nasal ones reach a distance behind the posterior edge of the orbit, the maxillary reach the commencement of the ventral or extend to a short distance beyond the end of the pectoral. Mandibulars are as long as, or a little shorter than, the head. It occurs in the submontane parts of the river, and is common in the River Jhelum above Rasul Head and in the River Sutlej near Ropar, and in canals as well. It is migratory and moves in shoals. It ripens earlier than *Pseudeutropius garua*, and ripe females have been stripped successfully in June. Many females caught in the beginning of July were spent. The temperature of water, where they spawn, ranges from 62°F. to 68°F. It is carnivorous and feeds on insects and their larvae and on small fishes. Takes worm, chilwa, piece of raw liver or clotted blood as a bait. It reaches one foot or more in length, and one of the largest female specimens, caught in the River Jhelum, measured 12·8″. Its flesh is rich, wholesome and well-flavoured.

GENUS: EUTROPIICTHYS.

Eutropiicthys vacha Ham. Buch. (*Vern. Jhalli, Challi, Bachwa, Barain, Dhungan, Dhuan, Baikiri, Baiki*) is another Bachwa. It has got a pointed snout and the cleft of the mouth extends to the posterior margin of the orbit. There are 8 barbels. The nasal barbels extend a short distance beyond the posterior margin of the orbit, the maxillary reach the middle of the preoperculum and the mandibular extend upto or a little behind the cleft of the mouth. It occurs in all the streams and is migratory. It moves in shoals. Its favourite resorts are the River Sutlej near Ropal, Ferozepore, and the River Beas near Talwara, Mirthal and Naushera. It is carnivorous, lives on insects, their larvae and on small fishes. It takes a 2′ spoon, clotted blood, raw liver and raw meat. It attains a foot or more in length and is considered excellent eating.

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[1] Day, F., *Faun. Br. Ind. Fish*, i, pp. 139-140.

GENUS : CALLICHROUS.

Callichrous bimaculatus Blotch (*Vern. Pallu, Pafta.* 'Butter Fish') occurs in all streams and is common in tanks. It has no adipose fin and possesses a long anal fin. It feeds mostly on insects and their larvae. Ripe females have been caught in August. It breeds during the rains, in July and August. It reaches a foot and a half in length. It is considered excellent eating and is one of the so-called Butter Fish.

Callichrous pabda Ham. Buch. is a smaller species, reaching 8 or 9″ in length. It is good eating, but females with ripe eggs are to be avoided during their breeding months, July and August, as they produce nausea when eaten.

GENUS : SILUNDIA.

Silundia gangetica Ham. Buch. (*Vern. Silund*) is another fresh-water shark and a scavenger of the rivers. It occurs in Jumna, near Tajewala weir, and has not so far been recorded from any river in the Northern Punjab. It is carnivorous and voracious. It grows to 6′ in length. The flesh is not wholesome, but owing to its cheapness and absence of intramuscular bones, it is much in demand locally.

GENUS : GLYPTOTHORAX.

Glyptothorax pectinopterum McClell. (*Vern. Mochi, Nao, Nai, Dhobia, Juppah, Nungrari, Kuggar, Pahari, Khagga*) is a hill Cat-fish with horse-shoe-shaped adhesive apparatus on the chest which enables it to adhere to rocks. It occurs in the hill streams of Kangra, Gurdaspur and Jhelum districts and often gets down the canals. It is less than a foot in length and is eaten by the local inhabitants.

Glyptothorax coniostre Steind. is another *mochi* or 'Cobber fish' differing from *G. pectinopterum* in having a wider mouth, a narrow head, broader barbels, and more elongated and adhesive apparatus. It occurs in Kangra and other hill streams. It reaches 8 or 9′ in length and is eaten by the local inhabitants.

GENUS : SACCOBRANCHUS.

Saccrobranchus fossilis Bloch. (*Vern. Singhi, Naulahi, Naulakhi*) is the much-dreaded 'Scorpion Fish', and occurs generally in sluggish waters, streams and tanks. 'It possesses accessory respiratory chambers in the shape of long air sacs, with vascular walls, lying internally to the trunk muscles and passing backwards close to the vertebral column.'[1] They are visible if the fish is dissected from the dorsal surface.

'Wounds from its pectoral spines are poisonous, cause fever and inflammation'.[2] Immersion of the fisherman's hand, when the wound had been caused, into 10 per cent formalin for a quarter of an hour gave great relief and checked the inflammation. The fish is killed and the spine broken before it is removed from the net. It breeds during the rains. The colour of the eggs is pea-green. They fry are of reddish colour. The fish grows to 1′ or more in length. Its flesh is said to possess invigorating qualities. But in the Punjab, these fishes are as much dreaded as snakes and are eaten by the poor and low caste people only.

GENUS : SISOR.

Sisor rhabdophorus Ham. Buch. (*Vern. Kirrla, Kirrlu*) as one of the Cat-fishes with osseous plates on the back. Its adipose fin is represented as a short spine, with upper caudal ray elongated into a caudal filament. It attains about 8″ in length excluding the caudal filament, and has been caught from the River Sutlej near Ropar, Deg Nala, and from streams in the Gurdaspur district. It is seldom eaten, but it is said to possess nourishing and medicinal qualities.

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[1] Day, F., *Fish. Ind.*, ii, 1878, p. 439.

[2] Day, F., *Faun. Br. Ind. Fish*, i, 1889, p. 126.

FAMILY: OPHIOCEPHALIDAE.

GENUS: OPHIOCEPHALUS.

Ophiocephalus marulius Ham. Buch. (*Vern. Saul*) is one of the snake-headed mud fish. It occurs in all the rivers and streams, prefers sluggish to swift running water, and is common in tanks. It is carnivorous and has fine pointed teeth in the jaws, vomer and palate. It lives mostly on small fishes, frogs and tadpoles. It possesses a respiratory chamber in the head. When the tanks or ponds become dry it burrows under the mud and remains there till fresh water releases it from its confinement. It is monogamous. During the spawning season, which lasts from April to June, a male and female make, near the bank, a floating nest of weeds or grass cut with the mouth. Spawning has successfully taken place in the Departmental tanks at Madhopur and Chhanawan. The reddish yellow eggs float and lie in the 'nest'. Each egg measures 2 mm. and a single large oil globule in the yolk makes each egg buoyant. The embryonic development goes on rapidly, but depends considerably on the temperature of water. The eggs hatch out in 54 hours in a temperature of 61°F. to 79°F., and in 30 hours in 83°F. to 92°F. The nest is guarded by the parents, and after a week or so the fry are taken out from the nest in the company of the parents, which guard them zealously for about six weeks. The fry swim together and frequently come to the surface leaving air bubbles, and are easily distinguishable by their bluish-black ground colouration. As soon as the fry begin to leave their parents and wander about, the parent fish themselves begin to devour them, and those which escape continue the progeny.

The colour of the adult varies with its environment. It is dark dirty green above, sides yellowish green, belly bluish white. There are 6 to 7 distinct black blotches over the lateral line with numerous pearly white spots. Pearly white spots are also present on the sides above the lateral line, and on the dorsal, caudal and anal fins. Fins dark grey. There is a large black ocellus with white margin at upper part of base of caudal fin. The ocellus[1] appears in fry ranging from 70 mm. to 90 mm. in length, age 7 weeks to 11 weeks, and remains distinct till the second year, when the fish reaches 15-18″ in length. Afterwards it becomes indistinct and is lost in the dark colour of the caudal fin. It grows to 4′ in length. Flesh firm, white and flaky, without any intramuscular bones, and with a wholesome agreeable flavour. It is considered excellent food.

Ophiocephalus striatus Bloch. (*Vern. Saul Daula*) occurs in sluggish streams and tanks and has bred successfully in ponds. It breeds from April to June and only once a year. It builds a nest or a receptacle near the banks and both parents mount guard. The fry move in groups, followed by the parents, and come to the surface to exhale air bubbles and are easily distinguishable by their soft reddish brown colour. In the adult there are bands of grey on the sides of the abdomen. It grows to 3′ or more in length and is considered excellent food.

Ophiocephalus punctatus Bloch. (*Vern. Daula*, *Karrar*, *Dalunga*) cocurs in all the rivers, streams, borrow pits, ditches and tanks. It burrows in mud and prefers stagnant and muddy to running water. It is carnivorous. Breeds once in the year, from April to June. It lays its floating eggs in a rude receptacle along the banks and guards its nest and fry. Ground colour of fry black and yellow. Often come to the surface to exhale air bubbles. It grows to a foot or more in length and is eaten by the local inhabitants but is bony.

Ophiocephalus gachua Ham. Buch. (*Vern. Dauli*, *Dhaunku*) is found in all the rivers, tanks, ditches and borrow-pits. Burrows under the mud in ponds which dry completely in summer, where it remains concealed till the rains release it from its captivity. It is very tenacious of life and has been kept alive out of water, and even carried long distances, for considerable lengths of time. It is carnivorous and destroys eggs and fry of other fishes. It is monogamous and breeds from April to June. When spawning[1] the pair lie submerged in clear but sluggish water without any nest or receptacle. The female turns upside down and the male lies above it crosswise, so that their genital pores are in close contact. Two or three hundred eggs are liberated at intervals of a minute or so, and the fish remain in the same position and at the same place till all the eggs have been laid. The male pours its milt at the same time. Eggs are floating. They rise to the surface of the water and spread there. The fish use their fins all the time to keep their balance. The eggs yellowish in colour, measure 1·5 mm. in diameter. The eggs and fry are guarded by the parents. The fry frequently come to the surface and are easily distinguishable by their yellowish brown ground colour. Ocellus with light edge on the dorsal fin mentioned by Day[2] is present in specimens of 1½ inch to 2 inches) in length. It attains a foot or more in length. It is eaten by the local inhabitants, but is bony. Its soup is nourishing.

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[1] Hamid Khan, *Journ. Bomb. Nat. Hist. Soc.*, xxx, 1925, p. 534.

FAMILY: SALMONIDAE.

GENUS: SALMO.

Salmo fario[3] Linnaeus, or Brown Trout was introduced into the Punjab from Kashmir in 1909 in the form of eyed ova and were hatched in Kulu. From small beginnings the culture of trout has progressed satisfactorily and wild trout are now breeding in many streams in the hills. The Brown Trout thrives in clear, cold, rapid, snow-fed streams. It is active in its habits and leaps over obstructions. It feeds on insects and on their larvae, worms, molluscs and small fishes. In hatcheries they are fed on slugs, snails, worms, minced meat, goat liver and fresh fish mixed with wheat or maize flour. Spawning begins in November and continues till February. The eggs measuring 4 to 6 mm. in diameter, are yellowish or reddish in colour. They are deposited at intervals in crude nests excavated by spawning fish and covered over with gravel. In the Department Hatcheries at Mahili (Kulu) fish are stripped from November to February as they ripen and ova after being fertilized are placed in trays in ova sheds. It takes 2 to 7 weeks, depending upon the temperature of water, for the eyes to appear. These eyed ova are quite hardy and can be moved without danger and sent to far off places. After 6 weeks more, the eggs are hatched out and 4 weeks later the fish begin to feed. By May and June the fry are collected from rearing ponds, taken in carriers and let into streams. Over a lac of fry are planted annually in the Beas and its branches in Kulu. Rivers and streams in the Punjab stocked with Brown Trout include

1. Ravi River in Chamba.
2. Beas River in Kulu and its branches.
3. Uhl River in Mandi State.
4. Baner and Gaj streams in Kangra and various other streams in Simla Hills.

Brown Trout in the Punjab have been reported to have reached 16 lbs. in weight.[4] The biggest hen fish in the pond near Srinagar (Kashmir), which was probably the mother of the first ova that came to Kulu weighed, when dead, 16 lbs. 1 oz. Brown Trout are one of the finest game fish, take artificial and natural fly and worms. Its flesh, wholesome and well-flavoured, without any intramuscular bones, is considered excellent eating. Its sale is confined to Kulu Valley only.

Salmo chasta[5] Jordan is *Salmo irridens* or Rainbow Trout of most writers and especially of fish culturists. It is, however, not *Salmo iridens*[6] (Gibbons), which is based on coastwise specimens. Five thousand Rainbow Trout ova were imported from Kashmir in 1920, but only 992 arrived to hatch out in Kulu. Out of these only 57 fry survived in the Hatcheries. In 1922 they came into season and were stripped, but the results were not satisfactory. The temperature of water in Kulu ranges from 33°F. to 38°F. in winter and 58°F. in summer, and it appears to have proved unfavourable for Rainbow Trout, which in their natural conditions are usually found in waters varying from 38°F. in winter to 70°F. in summer. They can live in water with comparatively higher temperature if it is plentiful and running with a strong current, and are found in swift running streams.

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[1] Hamid Khan, *Journ. Bomb. Nat. Hist. Soc.*, xxix, 1924, p. 961.

[2] Day, F., *Faun. Br. Ind. Fish*, ii, p. 364.

[3] Howell, G. C. L., *Journ.*, *Bomb. Nat. Hist. Soc.*, xxiv, 1915, p. 317.

[4] Mitchel, F. J., *Journ.*, *Bomb. Nat. Hist. Soc.*, xxiv, 1915, p. 371.

[5] Jordan, Evermann and Clark, *Rept. U.S. Comm.*, 1928, B.F. 1055, p. 58 and Jordan, D. S., *Fishes*, 1925, pp. 320, 321, figs. 230 and 231.

[6] Gibbons, *Proc. Calif. Aceda. Nat. Sci.*, i, 1855.

The Rainbow Trout breeds from January to February and lays its eggs in round or elongate nests, made on gravelly bottoms by the parents. The eggs sink into the nests and lie there protected until hatched. In the Departmental Hatcheries the fish are stripped from January till the middle of March. In May and June the fry are carried in tin carriers and put in the streams. Streams so far stocked in the Punjab are:

1. Beas in Kulu and its tributaries.
2. Luni Khad, Gaj, Baner and Binun streams in Kangara.

Rainbow Trout is a superior game fish and has wholesome, well flavoured flesh and is esteemed excellent as food.

FAMILY: NOTOPTERIDAE.

GENUS: NOTOPTERUS.

Notopterus chitala Ham. Buch. (*Vern. Pari, But, Moh*) occurs in all the streams, rivers and tanks in the plains. It has a laterally compressed body, and often swims on its side. It is carnivorous with teeth in jaws, vomer, palate and on the tongue as well. Ripe females have been caught in June. They breed in June and July. Eggs measure 3 mm. to 4 mm. each and are glutinous,[1] and adhere to objects on which they are deposited and are fertilized by the male at the same time.' During the laying and hatching the parent fish is said to guard its nest. It is said to grow to 3′ in length. 'The belly is uncommonly rich and well flavoured but the back contains numerous small bones, and a strong prejudice exists against this fish as food, owing to its being supposed to live on human carcases.'[2] In the Punjab, however, there is no objection to the eating of this fish. It is not very common in the market.

Notopterus[3] *notopterus* Pallas grows to 2′ and occurs in all the rivers and streams in the plains. Its belly is eaten, the dorsal portion is bony.

FAMILY: RHYNCHOBDELLIDAE.

GENUS: MASTACEMBELUS.

Mastacembelus armatus Lacep. (*Vern. Bam, Groj, Sample Machhi*) is regarded as one of the local Eels with spines on the back. It has a long cylindrical body and is very slippery. It occurs in all the rivers and tanks. It is carnivorous and has minute teeth in the jaws and is very destructive to eggs and fry of other fish. In the adult, the colour is brown above and yellowish on the abdomen. In the young there are three black bands passing from the eye backwards. The black band in the middle is on the lateral line. It is broad and becomes wavy posteriorly. It attains 2′ or more in length. Specimen caught from Chhanawan Fish Farm measures 27·7″ in length. In the Punjab, these spiny eels are considered to be as repulsive as snakes and are eaten only by low caste and poor people. The flesh is firm and tough and is said to be heating and invigorating.

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[1] Southwell and Prashad, *Rec. Ind. Mus.*, xvi, 1919, p. 217.

[2] Hamilton-Buchanan, *Fish, Ganges,* 1822, p. 382.

[3] Pallas, *Spicil. Zool.*, vii, 1769, p. 40; Weber, *Fishes, Indo-Austr. Arch.*, iii, 1913, p. 9; Annandale, *Rec. Ind. Mus.*, xiv, 1918, p. 53.

Mastacembelus pancalus Ham. Buch. is a smaller variety of spiny eel, attaining 7 inches in length and is occasionally caught on rod and line, and does not form an article of food.

GENUS: RHYNCHOBDELLA.

Rhynchobdella aculeata[1] Bloch. is another representative of this family. Only two specimens have so far been obtained from the River Sutlej measuring 151 mm. and 116 mm. respectively. There are four well defined ocelli having a white edge at the base of the soft dorsal.

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[1] Day, F., *Faun. Br. Ind. Fish*, ii, p. 331.

NOTES ON COORG BUTTERFLIES.

BY

Lt.-Col. W. M. Logan Home.

It may be of interest to members of the Society who collect butterflies to know of my experiences in Coorg during the season 1932-33.

The monsoon that year was distributed over a longer period than usual, in fact the S.-W. Monsoon was merged into the N.-E., so that rain continued into November, which undoubtedly had an effect on the appearance of butterflies. The usual post-monsoon hatch out was very much smaller than usual, some species appeared off and on throughout the period in markedly smaller numbers, while many species were conspicuous by their absence. Others, recorded by Yates as appearing in September-October, were not seen till the end of December to February. I have followed J. A. Yates' list in the order and naming he gives in vol. xxxiv, No. 4, and vol. xxxv, No. 1, to make comparison easy. (Many of the names and numbers have since been altered in Evans' latest edition.)

The district worked out was practically the whole of Coorg with the exception of the Tittimatti area and the Brahmagiris.

The period was from July 1932 to February 1933.

The species can be conveniently divided into 4 groups.

1. Those seen or caught throughout the period.
2. Those seen or caught between July and October, mostly W.S.F.
3. Those seen or caught between November and February, mostly D.S.F.
4. Those not seen at all.

Group I.—Those seen and caught throughout the year.

A. Papilionidae.

A. 2. 10β. **Byasa a. aristolochiae.**
A. 4. 19 β. **Papilio selenus daksha.**
A. 4. 25α. **Papilio polytes romulus.**
A. 6. 2α. **Zetides sarpedon teredon.**
A. 6. 3β. **Zetides doson eleius.**
A. 6. 8α. **Zetides agamemnon menides.**

B. Pieridae.

B. 1. α. **Leptosia nina nina.**
B. 6. 2. **Delias eucharis.**
B. 11. 1. **Catopsilia** **crocale.**
11. 2. **Catopsilia** **pomona** Not as common as crocale.
11. 4. **Catopsilia** **pyranthe** nina.
11. 5. **Catopsilia** **florella.** Not as common as pyranthe.
B. 19. β. **H. glaucippe australis.**
B. 15. **Terias.** **libythea, blanda siluetana.**
v. venata, hecabe simulata.

C. Danaidae.

C. 2. 1α. **D. a. aglea.**
2. 7. **D. limniace.**
2. 12. **D. plexippus.**
2. 14. **D. chrysippus.**

D. Satyridae.

D. 2. 9α. **Mycalesis p. typhlus** W.S.F. from August to November.
,, m. polydecta D.S.F. from November to February.
D. 22. 1. **Melanitis leda ismene.**
D. 24. **Parantirrhoea marshalli.** Rare. A few seen here and there in the 'wate' from August to February. Only 3 taken.

F. NYMPHALIDAE.

F. 18. 3.α. **Euthalia lepidea miyana.**
Urti Ghat.
F. 26. 6. α. **Neptis hylas varmona**
26. 3. 2. β. **Neptis hordonia.**
30. 1. **Hypolimnas misippus.**
2. **Hypolimnas bolina.**
F. 35. 6. **Precis ephita pluviatis.** Common all over the ghats.
F. 41. β. **Cupha erymanthis maja.**
49. 1. α. **Ergolis ariadne indica.**
2β. **Ergolis m. merione.**

H. LYCAENIDAE.

H. 14. 1α. **Castalius rosimon.** Not common.
H. 15. 2. **Tarucus theophrastus nara.** Not common.
H. 75. **Cheritra freja jaffra.**

I. HESPERIDAE.

I. 1. 6. **Badamia exclamationis.**
I. 20. 4. β. **Tagiades obscurus athos.**
I. 20. 9. **Tagiades litigiosa vajuna.**
I. 25. **Coladenia indrani indra.**
I. 26. 3. β. **Sarangesa d. davidsoni.**
1. 58. 5α. **Aeromachus pygmaeus.**
I. 61. 2α. **Iambrix salsala luteipalpus.**
I. 67. **Sancus pulligo subfasciatus.**
I. 105. 4. **Taractrocera c. ceramas.**

Group II.—Those seen and caught between July and October only (during the rains).

A. PAPILIONIDAE.

A. 1. **Troides minos.** Plentiful from July to October, after which it disappeared.

A. 2. 8β **Byasa jophon pandiyana.** Scarce. Only seen and caught during July to August, all those seen only flew in dull or actually rainy weather.

A. 2. 9. **Byasa hector.** Plentiful from July to October. It disappeared, like T. minos, after October.

A. 4. 1β. **Papilio p. polymnestor.** Plentiful.

A. 4. 10α. **P. paris tamilana.** Plentiful. None seen after October.

A. 4. 14. **P. buddha.** Not uncommon, mostly low down.

A. 4. 16. **P. dravidarum.** Scarce. Only one caught. This species appeared for a very short period, end July to August.

A. 4. 26α. **P. d. liomedon.** Scarce. Only one caught and very few seen.

C. DANAIDAE.

C. 1. 1.β. **Hestia l. malabarica.** Not uncommon from Urti upwards.

D. SATYRIDAE.

D. 15. 1. **Zipoetis saitis.** Not uncommon in 'wate', not seen after October.

D. 25. 1α. **Elymnias h. caudata.** Scarce, a few seen and caught in August to September; low down.

F. AMATHUSIIDAE.

F. 20. β. **Parthenos s. virens.** Not uncommon from August to October after which it disappeared.

F.24. 7β. **Limenitis procris undifragus.** Well distributed all over the ghats, but nowhere common. A difficult species to catch.

H. HESPERIIDAE.

H. 105. 2β. **Taractrocera m. flaccus.** Very rare, only one seen and caught on 15-9-32.

Group III.—Those species seen and caught between October to February; after the rains.

A. PAPILIONIDAE.

A. 3. 5 β. **Chilasa clytia clytia** { Scarce, a few seen, mostly dissimilar,
v. dissimilis. { low down on ghats.

A. 4. 27α. **Papilio d. demoleus.** Common.

A. 5. 6β. **Pathysa antiphates naira.** Very scarce. 5 seen and all caught, sitting among myriads of *Appias a. darada* at edge of river at Maukut, on 22-1-33, none seen previously to this date, though I had visited the place frequently, expecting to see them.

B. PIERIDAE.

B. 7. 2. **Prioneris sita.** Scarce. A few seen above Vitecolli from October onwards; 3 caught out of a bunch of 10 sitting on wet sand on the Paiaswami river at m. 13 ? on 27-12-32.

B. 9. 2α. **Huphina n. evagete.** Common between Urti and Vitecolli.

B. 9. 3 β. **H. nadina remba.** ♂♂ common from October on, the only 2 ♀♀ seen were taken by me on 20-10-32.

B. 10. 3α. **Appias indra shiva.** Scarce. A few seen near Vitecolli in October only.

B. 10.5 β. **A. lyncida latifasciata.** Very rare. One only seen (and missed) sitting among a host of *A. a. darada* near Maukut. Curiously enough, I took 2 and saw others in my compound at Cannanore in June.

B. 10. 6 β. **Appias albina darada.** First seen on 2nd October, after which it disappeared till it reappeared in myriads at the end of December, all along the river from Urti downwards.

♀ *var. semiflava.* Scarce. Only a few seen and 3 caught on 22-1-33.

B. 10. 7β. **A. p. wardii.** None seen till January when it appeared with the last named in fair numbers.

B. 17. 1. **Ixias marianne** { Common from Urti to 2 miles below
B. 17. 2β. **Ixias pyrene frequens** { Vitecolli.

B. 18. **Colotis. fausta.** Seen and taken about 1 mile above Urti in November.

C. etrida and **C. danae** also seen at the same spot.

C. DANAIDAE.

C. 3. **Euploea c. coreta** Fairly common above Urti.

D. SATYRIDAE.

D. 2. 3α. **Mycalesis a. anaxias.** *Very rare.* Only one seen and caught, on Sampaje ghat at m. 13 on 29-10-32. I never saw any in the 'wate', where Yates records it flying with *Z. saitis;* though I combed out the area from above Vitecolli right down to below Urti. I frequently disturbed *D. l. lepida* but nothing else besides *Z. saitis,* and a very occasional *Parantirrhoea marshalli.*

D. 2. 32β. **M. p. junonia.** Only taken close round Vitecolli in November, none seen there (or anywhere else), before or after.

D. 3. 24α. **Lethe rohria nilgiriensis.** Fairly common.

D. 3.25 β. **L. drypetis todara.** Very common round Vitecolli, but nowhere else.

D. 16 α. **O. medus mandata.** Commonest in the Eastern jungles from November to January; it swarmed in Nagerhole in December. Very few seen on the ghat road.

D. 22. 2 β. **Melanitis phedima varaha.** Not met with till October, when 2 or 3 W.S.F. were taken near Vitecolli; later on, in November, D.S.F. were common at the same spot, and also at m. 13. Sampaje ghat.

D. 22. 3α. **Melanitis z. gokala.** Rare. Saw and took a few on the Sampaje ghat road in December.

E. 10. 3 β. **Discophora l. lepida.** Not uncommon. First seen near Urti at end of October; fresh specimens caught up to 22-1-33.

F. NYMPHALIDAE.

F. 1. 2 β. **Charaxes polyxena imna.** Rare. Only 2 seen, one on Sampaje ghat, sitting on shingle, and one, also sitting on shingle, at Maukut. A difficult insect to catch.

F. 1. 7 β. **Charaxes f. fabius.** Rare. Only one seen and taken, on human excreta at roadside, below Urti.

F. 2. 1 a. **Eriboea sch. wardi.** Very rare. Only one seen (and missed) sitting on cowdung in middle of the road below Urti.

F. 2. 2 β. **Eriboea a. agrarius.** Common from December onwards, mostly from Urti downwards.

F. 6. 8 β. **Apatura p. atacinus.** Rare. One ♀ taken on Sampaje ghat on 27-12-32. No others seen.

F. 18. 26 β. **Euthalia e. laudabilis.** Rare. One only seen on Urti ghat.

F. 25. **Pantoporia ranga karwara.** Rare. A few seen near Vitecolli in November.

F. 26. **Neptis c. nilgirica.** Rare. Only seen on Sampaje ghat.

F. 27. 4 a. **Cyrestis th. indica.** Common on the Sampaje ghat, only a few seen on the Urti ghat.

F. 34. 1 β. **Kallima philarchus horsfieldii.** Rare. One or two only seen on the Sampaje ghat in December, and one seen at Maukut in February.

F. 35. **Precis.** All seen, *atlites* the commonest.

F. 36. 1. **Vanessa canace viridis.** Not common. Mostly high up, Vitecolli and above.

F. 42. 1. **Atella phalanta.** Fairly common.

F. 42. 2 β. **Atella a. mercea.** First seen on Sampaje ghat in October, later found all over both ghats, but not high up.

F. 44. β. **Cynthia erota saloma.** Rare. No ♀♀ seen at all. None seen after November.

F. 45. 4 β. **Cirrochroa t. thais.** This only appeared at end of October.

F. 47. 2 β. **Cethosia m. mahratta.** Rare. ♀♀ especially so. Not seen after November.

F. 52. **Telchinia violæ.** Not common.

G. 1. 3. β. **Libythea myrrha carma.** Very local; appeared at beginning of January, near Urti only.

G. 4. 5 β. **Abisara echerius suffusa.** Not common, a ♀ taken at Vitecolli in November.

H. LYCAENIDAE.

With the exception of:—

Castalius rosimon.
Tarucus t. naira.
Cheritra f. jaffra.

The Lycaenids appeared in October and continued up to February, when I left the area. Those not seen at all are given in Group IV.

I. HESPERIIDAE.

I. 16. 13 a. **C. l. leucocera.** Rare. Only 2 seen and taken.

I. 25. 2. **Col. d. dan.** Not rare. From Urti to Vitecolli.

I. 31. 1. **O. angulata.** Not rare. Appeared early in December.

I. 32. 1. **Caprona r. photiphera.** Not rare. Low down on Urti road.

I. 34. **S. galba.** Scarce. A few seen at Mercara in December.

I. 56. 2. **Baracus v. hampsoni.** Rare. One one seen and taken at Sampaje.

I. 62. 1 a. **Suastus gremius.**

I. 74. 3 a. **Notocrypta p. alysia.** Rare. Only 2 seen at Vitecolli in November.

I. 74. 5. **Notocrypta curvifascia.** Rare. Only 2 seen at Vitecolli in November.

I. 75. 1 β. **Gangarat. thyrsis.** Rare. One seen at Maukut. This species is very common on the coast, large numbers used to arrive on the flowers of the club garden at Cannanore after sunset, in January 1933.

I. 99. 4. **Halpe hyrtacus.** Rare. One taken on 'ramtulasi' at Vitecolli, 2 others seen at same spot, in November.

I. 106. 7. **Padraona d. pseudomoesa.** Scarce. A few seen and taken at end of October near Urti.

I. 106. 8 β. **P. p. tropica.** As above.

I. 108. 1. **Telicota a. augias.** Scarce. As above.

I. 108. 2 a. **Telicota p. bambusae.** Common and well distributed.

I. 115. 15β. **Baoris p. philippina.** Rare. 2 caught and seen at end of November at Vitecolli.

I. 115. 18α. **Baoris conjuncta narooa.** Rare. One only seen and caught at Mercara at end of December.

I. 115. 23. **Baoris p. contigua.** Scarce. One only seen and caught at Vitecolli in December.

I. 115. 30β. **Baoris zelleri collaca.** Not uncommon, from November onwards.

Group IV.—Those species not seen at all.

A. PAPILIONIDAE.

A. 4. 13. **P. crino.**

B. PIERIDAE.

B. 8β. **Belenois m. mesentina.**
B. 10. 4α. **Appias l. libythea.**
B. 20 2α. **Pareronia c. ceylonica.**
B. 20. 3. **Pareronia v. hippia.** This species was taken by me at Cannanore, but not in Coorg.

C. DANAIDAE.

Danais d. nilgiriensis.

D. SATYRIDAE.

D. 2. 11. **Mycalesis igilia.**
D. 2. 14. **Mycalesis subdita.**
D. 2.16 β. **Mycalesis khasia orcha.**
D. 2. 20. **Mycalesis khasia adolphei.**
D. 42. 3α. **Lethe europa ragalva.**

F. NYMPHALIDAE.

F. 10. 1α. **Euripus c. meridionalis.**
F. 19. 10. **Euthalia telchinia.**
F. 18. 14β. **Euthalia g. meridionalis.**
F. 18. 17β. **Euthalia l. arasada.**
F. 18. 27. **Euthalia nais.**
F. 33. β. **Doleschallia b. malabarica.**
F. 36. 1. **Vanessa cardui.**
F. 36. **Vanessa indica pholoe.** I searched the localities at Mercara in December (mentioned by Yates), but saw none.
F. 48. **Byblia illythia.**
G. 1. 2α. **Libythea l. lepitoides.**
G. 4. 5α. **Abisara echerius prunosa.**

H. LYCAENIDAE.

H. 5. 4. **G. biggsii.**
H. 16. 3β. **Euchrysops p. pandava.**
H. 20. 16. **Lycaenopsis l. lilacea.**
H. 21. α. **Chilades laius.**
H. 22. 1α. **Zizera trochilus putli**
H. 32. 1. **Azanus uranus.**
H. 32. **Azanus jesous.**
H. 4 . 1β. **Iraota t. timoleon.**
H. 47. 1β. **Horsfieldi a. anita.** This species was abundant on the Kodaikanal ghat road in May 1932, but I never saw one in Coorg.
H. 48. α. **Thaduka m. kanara.**
H. 50. No **Amblypodia** seen except *centaurus pirama* and this was scarce, though common at Cannanore.
H. 57. **Apharitis lilacinus.**
H. 58. No **Spindasis** seen at all.
H. 59. **Zesius chrysomallus.**

H. 61. No **Pratapa** seen.
H. 65. No **Tajuria** seen.
H. 82. No **Horaga** seen.
H. 83. **C.e. myositina.** This was not uncommon on the Kodaikanal ghat in May, but I never saw it in Coorg.
H. 84. No **Chliaria** seen.
H. 88. No **Deudoryx** seen.
H. 89. No **Virachola** seen.
H. 90. No **Rapala** seen in Coorg, but I took *R. schistacea* in Malabar.
H. 92. No **Bindahara** seen.

I. Hesperiidae not seen.

I. 16. **Hasora b. badra.**
1. 12. **Hasora alexis.**
1. 13. **Hasora t. taminatus.** Several taken in Malabar but not seen in Coorg.
I. 2. **Ismene.**
I. 3. **Bibasis**
I. 5. **Rhopalocampta benjamini.**
I. 16. 1. **Celaenorrhinus ambareesa.** Taken on the Vaitri but not seen in Coorg.
I. 16. 19. **Celaenorrhinus ruf. area.**
I. 26. **Sarangesa purendra.**
I. 28. **Tapena thw. hampsoni.**
I. 54. β. **Astictopterus j. olivasces.**
I. 57. 1. **Amphittia dioscorides.**
I. 60.1. **Arnetta vindhiana.**
I. 62. 3 . **Suastus rama bipuvetus.**
I. 80. **Matapa aria.**
I. 82. 1β. **Hyarotis a. adrastus.**
I. 82. 2. **Hyarotis basiflava.**
I. 83. **Stys (Kineta) microstictum.**
I. 87. **Plastinaga s. kanara.**
I. 99. 8. **Halpe** {
sitala.
astigmata.
honorei.
moorei.
I. 99. 33*a*. **Halpe homolea.**
I. 103. **Cupitha purreea.**
I. 104. 1. **Nicevillea concinna.**
I. 104. 2. **Nicevillea gola.**
1. 115. 1. **Baoris oceia farri.** Taken in Malabar only.
1. 115. 5*a*. **Baoris s. subochracea.**
1. 115. 6γ. **Baoris mathias.**
1. 115. 14. **Baoris kumara.**
1. 115. 28β. **Baoris guttatus bada.**
1. 115. 29. **Baoris canaraica.**
1. 115. 31 β. **Baoris bevani bevani.**

Points of special interest are the extreme rarity of certain species which Yates recorded as quite common.

Such were (1) *Mycalesis a. anaxias;* for which I searched all over Coorg, but only obtained one specimen, on the Sampaje ghat, in October.

(2) *Mycalesis p. junonia.* This species was very common this year (1933) in the Nilgiris, but it was scarce in Coorg in 1932-33.

(3) *Apatura p. atacinus.* This butterfly is common at Kodaikanal, but I only saw and caught 1, a ♀ in Coorg.

(4) *Cynthia erota saloma.* This was quite common on the Manantoddy Ghat road (Malabar), but it was rare in Coorg.

ON THE BIRDS SEEN OR COLLECTED BY MR. H. ST. J. PHILBY DURING HIS EXPEDITION TO CROSS THE RUB AL KHALI.

BY

N. B. Kinnear, M.B.O.U.

(Zoological Department, British Museum).

During his journey through the 'Empty Quarter', or the Rub al Khali, Mr. Philby collected a number of birds which were presented to the British Museum by H. M. King 'Abdul 'Aziz ibn Saud of Arabia. They consist of 37 specimens belonging to seventeen species. In addition Mr. Philby kept daily notes of the birds seen which he has included in his book *The Empty Quarter*, and these notes I have extracted which, together with the specimens, form the basis of this paper. Of the birds collected the Arabian Stone-Curlew, Cream-coloured Courser, Houbara (also a winter visitor), Bifasciated Lark, Arabian Black-tailed Lark and Raven are residents; the Desert-Warbler is also probably a resident and perhaps the Aucher's Shrike. The remainder —the Sparrow Hawk, Scops Owl, Hoopoe, Wagtails, Persian Short-toed Lark, Eastern Desert Wheateater, Pied Chat, Persian Stone-Chat are either winter visitors or migrants passing through to their breeding grounds further north.

It is unnecessary to give a description of the journey, since Mr. Philby has given full details in his book, and in a more condensed form in the *Journal of the Royal Geographical Society*, vol. lxxxi, pp. 1-26 as well as in the *Times* newspaper. For those, however, who have not read any of these accounts it will suffice to say that Mr. Philby started from Hufuf in Hasa on 6th January 1932, and went S.-E. to the head of the Gulf of Bahrain, from there S.-W. to the Jabrin oasis, thence more or less due south to about latitude 19°, the furthest point south reached. The expedition then eventually went due west to Sulaiyil which was reached on 15th March.

The monotony of desert travelling was frequently relieved by the presence of desert warblers or bifasciated larks, but the sight of migrants on their way north, especially on the march through the dead world of sand, was specially pleasing and Mr. Philby describes how he was thrilled by the sight of a hoopoe and a passing swallow. Then, after the final effort over the 'waterless waste', as he calls the desert of the last five or six days of the journey, Sulaiyil was reached and:—'the *Sarh* trees in full bloom were a delight after the treeless desert, standing 20 to 30 feet high, as also the acacias, adorned with their charming yellow tassels. Birds sang or twittered in their branches and swallows swooped low along the ground snapping up the insects that hummed gently among the flowers of spring. It was indeed a charming scene!

Mr. Philby unfortunately had very little previous experience in preparing specimens, and it was no wonder that he found the skinning of birds a great tax on the short time available at the end of each day's march. Three or four days after starting he came to the conclusion that he could no longer prepare birds himself since, he writes:—'I had to do everything myself and found in consequence that everything was falling sadly into arrears. Even my journal was not up to date, and I was aware from previous experience that arrears of work accumulated beyond a certain point can never be overtaken. This applied frequently to the collecting of birds and mammals which had either to be skinned when fresh or thrown away before they came too unpleasant. So far we had met with little to shoot except a few birds, but most of these had been thrown away and I regretfully arrived at the conclusion that to make time for other things I must jettison the activities connected with collecting anything that required skinning. Before doing so, however, I decided, as a forlorn hope, to teach Sa'dan the very little I knew about the art of skinning. So we struggled that night with the curlew, the blind leading the blind, and after a day or two of similar joint efforts it was he who took on the whole responsibility of preparing the specimens collected during our wanderings!'

With the help of Sa'dan, his servant, Mr. Philby managed to get together the collection of skins, indifferent perhaps as cabinet specimens, but sufficient to show what species inhabit these desolate and arid regions. At Shanna, the furthest point south reached by the expedition and about half way, unfortunately Mr. Philby's gun was put out of order and so no further specimens could be obtained, but he continued to keep careful notes of all the birds he saw. Mr. Philby is to be heartily congratulated on the collections he made, in spite of the many difficulties and discomforts of desert travelling. In addition to the birds he brought back 24 mammals, 81 reptiles and amphibia, over 370 insects, a number of recent and fossil shells, many rock specimens, several pieces of meteorites and a collection of plants, all of which have been presented to the British Museum by H. M. King 'Abdul 'Aziz ibn Saud of Arabia.

Burhinus oedicnemus astutus. Arabian Stone Curlew.

♀ 10 January Jaub Ba'aij; 11 January Jafura.

Native name.—Karwān.

Cheesman met with this Stone Curlew in the Jafura desert and shot one at Salwa, where also Mr. Philby obtained an example on 11 January and another at Jaub al Ba'aij on the 10th. Just south of latitude 20° at 'Ain Sala, in the Rub' at Khali, tracks of a Stone Curlew were noted in the vicinity of the camp and though the bird was never seen it appeared from its tracks to have visited the camp every night during the five days' stay. Mr. Philby remarks that 'its persistence suggested some attraction by the water or moisture of the well area' but since the well at this camp was a 'dead' one there must have been something else which was attracting the bird. Tracks of another were seen further south in the Hibaka tract, but again the bird itself was not seen.

The Arabian Stone Curlew ranges right across Arabia and in addition to Cheesman's examples we have specimens from Mascat and two from the Amiri district of the Yemen. Meinertzhagen collected two near Aden in January. Beyond these limits it is found in Iraq, Southern Persia and Baluchistan.

Chlamyodotis undulata macqueenii. Houbara.

1? 4 February Hadida.

Native name.—Houbara.

In the appendix to *The Empty Quarter* I omitted to state that the Houbara breeds in Arabia as well as coming there in winter. Mr. Philby found a nest with four eggs on 10 April 1918 near Shauki, between Hafaral Batin and Rujadh and Major Cheesman had three eggs given him, which were taken between Hufuf and Rujadh on 14 February. He also saw tracks in Jabrin in February. Of the Houbara in northern Jafura, Mr. Philby writes 'Tracks of bustard were observed quite frequently, but only once during these early days did we have a distinct glimpse of the bird itself, which has now grown very timid of man's presence and is being rapidly thrust back into the more inaccessible parts of the desert by the new habit of hunting with motor cars. Ibn Jiluwi, like the King himself, decimates them at the rate of 50 or 60 a day in his shooting expeditions, and one wonders how long the bird, presumably a migrant to Arabia, where it breeds, will take to develop an aversion for these parts of the country where cars can overtake their rapid flight'. We, I regret to say, introduced this pernicious sport of hunting both gazelle and bustard by motor car, and during the war in Iraq a general order was issued forbidding the hunting of gazelle by motor car. Mr. Philby tells me that in certain parts of Arabia gazelle have been practically exterminated through continual shooting from cars and the numbers of Houbara are bound to be affected if this form of hunting is continued, unless the birds betake themselves, as Mr. Philby suggests, to parts where they cannot be pursued in a car. But the Houbara is not only hunted with motor cars since the Arabs still take it in the old way by falcons and three so captured were presented to Mr. Philby by a young Shaikh. In Southern Jafura tracks are also seen and at Sanam in Wabar on 4 February fresh tracks were met with and 'Ali following them up with my gun brought back the only specimen of the bird to be secured during all our wanderings.' Near Naifa, well in the middle of the Rub al Khali tracks were seen abundantly, also in the Bani Jafnan district and at Unm al Tina near the most southerly point reached by the expedition three were actually seen. These records of actual birds and tracks have been given in full to show that the Houbara ranges right across the Rub al Khali. This bustard breeds in Central Asia, Baluchistan and Persia westwards to South Russia and Syria. In winter it moves south and is not uncommon at that season in north-western India, while, though some breed in Arabia, the majority found there in the cold weather are probably winter visitors. Stragglers not unfrequently occur in Europe and four examples have been recorded from the British Isles.

Cursorius cursor cursor. Cream-coloured Courser.
♂ 19 December Ma'aizila (near Riyadh).
Native name.—Daraja or *Darjalan.*

This was the only specimen collected but Mr. Philby had previously met with this species at Riyadh and remarks that 'in Northern Jafura the Cream-coloured Courser was fairly often seen but by no means as plentiful as I have found it in other parts of the country'. A single example was obtained by Col. Miles at Mascat. Cheesman met with it near Hufuf and it occurs near Aden.

The Cream-coloured Courser breeds in the arid or semi-arid areas from Algeria to N.-W. India and some in winter are found as far south as Somaliland.

Vultures.
Native name.—Nasr.

In Northern Jafura a pair of vultures were seen which Mr. Philby was unable to identify. He writes:—'A diversion was created by the appearance of a pair of vultures (Nasr) at which Ibn Humaiyid had an unsuccessful shot after some elaborate manoeuvring while 'Ali Johman, his close relative, stoutly refused to try his prowess on such creatures. The Oryx-hunter, he said by the way of explanation, does not go after such carrion. But it transpired later that, in the days when he had studied religion seriously, his teacher had discouraged the shooting of the unclean bird'. Major Cheesman saw both the griffon (*G. fulvus*) and the Egyptian vulture (*N. percnopterus*) in Hufuf.

Acquila sp.? Eagle.
Native name.—'Agāb.

Eagles are reported by Mr. Philby on several occasions, but unfortunately no specimens were obtained. A pair were stalked and missed on the Esturary of Jiban, one was seen in Jafura and another unsuccessfully approached above the plain of Shuqqat al Khalfat. After Mr. Philby's gun was out of action one was observed at close quarters near Ziqirt, 15 miles from Naifa and again in the Bani Jafuan, while in the Hibaka Qa 'amiyat district 'afar off ahead of us an eagle was soaring about in stately solitude, stalking food'. Cheesman saw a very dark eagle at Jabrin chasing a hare, Yerbury and Barnes reported the Golden Eagle (*Aquila chrysaëtus*) near Aden, but obtained no example, while the latter author also records *Aquila imperialis* from the same locality, but again was unable to confirm his observation by a skin. The only species actually recorded from S.-W. Arabia is the Abyssinian Tawny Eagle (*Aquila rapax raptor*), which Meinertzhagen obtained near Aden on 13 April 1923.

Accipiter nisus nisus. Sparrow Hawk.
♀ 12 January Anbak.
Native name.—Shabbut.

At Anbak on 12 January Mr. Philby writes 'Tamarisks also struggled with reeds and palms for existence, and a pair of Sparrow Hawks ("Shabbut") seemed to have good hunting amongst the numerous warblers and small creatures until one of them was stalked by Salih and shot at such close range with my gun that its head was almost completely blown off'. Further north at Hufuf Cheesman also met with a pair in November and on 10 April 1921 he saw one at Bahrain. To the southwards there are other records of the Sparrow Hawk—a male was obtained by Col. Yerbury at Lahej on 8 March and he reported the species to be not uncommon in the Aden district, where also Col. Meinertzhagen shot a female on 24 January.

This form of the Sparrow Hawk breeds in Europe and Western Asia and some migrate as far south as the Sudan and Abyssinia.

Otus scops scops. Scops Owl.
1-13 March Hidbat al Farsha.
Native name.—Qubaisa.

After crossing the waterless desert and the gravel plain the expedition passed into a country still covered with gravel, but intersected with numerous channels along which grew a dark green plant the 'Harmal' of the Arabs (*Rhazya stricta* Dcne.) and Acacia bushes. Here a Scops owl was found by Salih in the deserted burrow of a spiny-tailed lizard ('Dhabb').

At Shanna on February 22 Mr. Philby heard a small owl, which he took to be this species, but was unable to locate it.

The Scops Owl is a migrant in Arabia and we have in the British Museum an undated example collected by Col. Miles at Muscat, another obtained by Barnes near Aden on 28 September and a female shot by Bury on 21 March in the Amiri district. These are all the records for S.-E. and S.-W. Arabia I know of for this little owl, which breeds in Europe eastwards to Asia Minor and Palestine and migrates south in winter as far as Uganda. It is a rare wanderer to the British Isles.

Upupa epops epops. Hoopoe.
Native name.—Húdhud.

About the middle of the Sanam, on 4 February, a hoopoe was seen, which Mr. Philby says gave him as great a thrill as the swallow in the Numaila sands, he adds 'Salih went in pursuit and after an elaborate stalk fired at it, but the only result was to hasten its passage.'

According to Cheesman the Hoopoe does not winter in Hasa, but he noted it on passage during March. In the Aden district however, it appears to be a cold weather visitor and there are specimens or records of it in January, February, March, July, August and September.

Motacilla alba subsp.? White Wagtail.
1?-15 March Sulaiyil.
Native name.—Aqaili or *mislik.*

This single example is not in sufficiently good condition to identify the race, but probably it is the Indian White Wagtail *M. alba dukhunensis*, recorded by Cheesman as a common winter visitor to the Hasa oasis. He also noted it at 'Uqair on 6 March, on the 29th at Salwa and again on 5 April all of which he considers were probably migrants on their way north. Meinertzhagen also observed small parties of this same race moving north at Aden early in February, the movement continuing till about 25 April.

Mr. Philby records seeing wagtails in the desert on two occasions, which may have belonged to this race. The first was on the second day out from Naifa, at the close of a march of 27 miles through a particularly lifeless region, described by Mr. Philby as 'very depressing and only relieved by the presence of a wagtail and a desert warbler'. The second occurrence was a few days later during the crossing of Shanna when 'a wagtail greeted us with its unfamiliar chirrup and fled from us with graceful dives, but it was the only sign of life in that waste scene.'

Motacilla feldegg feldegg. Black-headed Yellow Wagtail.
? 14 March, 2 [♂] 15 March 1932 Sulaiyil.
Native name.—Sa'u ♂ Sa'wa ♀.

These three examples were obtained at Sulaiyil after completing the desert journey. According to Yerbury and Barnes, this species is occasionally met with in the Aden Protectorate and we have in the Museum a female from thence, shot by Chevallier in May 1885, as well as a male obtained by Messrs. Percival and Dodson on 20 September 1899. Major Cheesman saw this wagtail on migration at 'Uqair in March.

Suliva nana nana. Desert Warbler.
?♀ 6 February Sanam; 1-7 February Majari; 1-8 February Bani Jallab; 11 February 'Ain Sala ♂ 12 February Adraj.
Native name.—Suwaiwala.

Cheesman found the Desert Warbler common in Jabrin and Mr. Philby obtained specimens as far south as 'Ain Sala, latitude 19°57′ N., right in the middle of the Rub 'al Khali, some seventy miles north of his most southerly point. He remarks that 'it was interesting to see how these little warblers fly from bush to bush almost invisibly in long graceful swoops close along the ground—to avoid the keen eye of hawk or raven.' While crossing the waterless waste, after leaving Naifa, he records on 6 March that 'the only living thing we saw before our morning halt about 11 a.m. was a single Desert Warbler.' During the rest of the march the country became more and more bare with only scattered *abal* bushes and very little (though still something) of other plants.' The absence of any life became very depressing and by the end of the day's march—twenty miles—only four birds had been seen, another desert warbler, a wagtail and a single raven. On the next day the desert was more lifeless than ever and all the plants were dry and dead, the only sign of life being a swallow passing on migration, a butterfly and a desert warbler while on the following day in similar drought-stricken country another desert warbler was disturbed in passing.

This little warbler breeds in the desert parts of Eastern Persia and further north in the Caspian region. It may perhaps breed in Arabia and Palestine but there is no definite information. In winter it is found in Egypt, Palestine, Arabia and N.-W. India.

Lanius excubiter aucheri. Aucher's Shrike.

♀ 21 November 1931 Qai 'iya 3,500.

This single example was collected in Najd before commencement of the journey proper. Mr. Philby saw a shrike at Shanna, the only one seen during the crossing, which he thought was the same. This shrike is often confused with *L. e. palliderostris*, but we have examples in the Museum from South Jabrin (Cheesman), Muscat (Cox and Mills) and Aden and vicinity (various collectors).

It breeds in Persia, Iraq, parts of Northern Arabia and Palestine migrating in winter as far south as Somaliland.

Alaemon alaudipes doriae. Bifasciated Lark.

1 ♂ 2 ♀, 25 January, Maqaimama; ♀ 27 January, Hawuja, ♂, 1?, 31 January Tuwairifa; 1?, 1 February, Sa'afij; ♀ 6 February Sanam.

Native name.—Umm Sālim.

The Bifasciated Lark was met with at many places throughout the journey and, along with the Raven and the Desert Warbler, was the most frequently seen bird. It is found in the interior of the Rub al Khali as also are these two species.

Apparently these larks were more often heard than seen and Mr. Philby mentions time after time that he heard the piping note but could not make out the bird. This is not to be wondered at since this lark must be very difficult to see, on account of its sandy colour, as long as it keeps still. On the march to Faraja, Mr. Philby writes 'The only sign of life on the whole march had been a single Bifasciated Lark, whose piping announced its presence long before I could detect it tripping along the ground out of our way. In all these bare districts the desert birds seldom seem to take to their wings, generally preferring to run along the ground which provides them with almost perfect protection from birds of prey. A flying bird is often betrayed by its dark shadow on the ground! On 6 March Mr. Philby again writes 'a pair of larks piped at each other in the cool, still air of the morning, the notes of the sexes being as I thought, very different.' Later while crossing the gravel plain the only living thing actually seen in that desolate waste was one of these larks.

Calandrula rufescens persica. Persian Short-toed Lark.

♀ 23 January 1932 Summan camp near 'Uj 22°40′ N.; 1? 29 January 1932 Numaila 22°56′ N.

Native name.—Hamrā.

This Short-toed Lark, which breeds in Persia, was obtained by Cheesman at Umm-al Salar, Hufuf in January and December. In Mr. Philby's book I recorded this lark as *C. bracdyctta hermonensis*, but the specimens have since been cleaned and turn out to be the above species.

Ammomanes cinctura pallida. Arabian Black-tailed Sand Lark.

♀ (?) 22 November 1931 Khufaifiya, Najd; ♀ 14 January 1932 Jafura.

Native name.—Hamrā.

Previous to Major Cheesman's discovery of this small desert lark in Hasa it was only known from the type, which came from Qunfida in the 'Asir Province on the Red sea littoral. Then in 1930 Mr. Thomas collected a specimen in Dhufar and now Mr. Philby, besides obtaining an example in Jafura, also procured one at Khufaifiya west of Riyadh. This bird is probably widely distributed over Arabia and two birds collected at the south end of the Red Sea in 1909 by Mr. Douglas Carruthers, appear to belong to this race. The two specimens listed, I at first thought were darker than Hasa examples, but this was due to the feathers being soiled with grease.

Oenanthe deserti atrogularis. Eastern Desert Wheateater.

♂ 24 January Maquainama; 2 ♂ 31 January Tuwairifa; ♂ 2 February Sa'afij.

Native name.—Umm Ghurair.

This Desert Wheatear nests in Central Asia and passes south in winter to North Africa and India, many wintering in Arabia. Stragglers have occurred in the British Isles, in Kent and the Orkney Islands.

Bertram Thomas obtained one at A'ain water-hole on the edge of the Rub al Khali in January and a second at Sa'atan in Dhufar on 30 February. According to Cheesman this is the most plentiful wheatear in Jabrin during the winter and he obtained specimens in November and February, while Meinertzhagen found it common at Aden, where Kalsal also collected a male in February and near Lahej Percival and Dodson met with it in September.

Oenanthe leucomela. Pied Chat.

♂, [♀] 15 March 1932 Sulaiyil.

Native name.—Bijri or *Da'ja.*

This specimen was brought to Mr. Philby at Sulaiyil after the desert journey had been completed. Major Cheesman records Pied Chats on migration at Jabrin, Bahrain and Salwa in February, March and April and there are other records of it during the spring and autumn migration from Mascat, the Yemen and the Aden district, where a certain number of birds appear to pass the winter.

Saxicola torquata maura. Persian Stonechat.

15 March Sulaiyil.

Native name.—Busaiya.

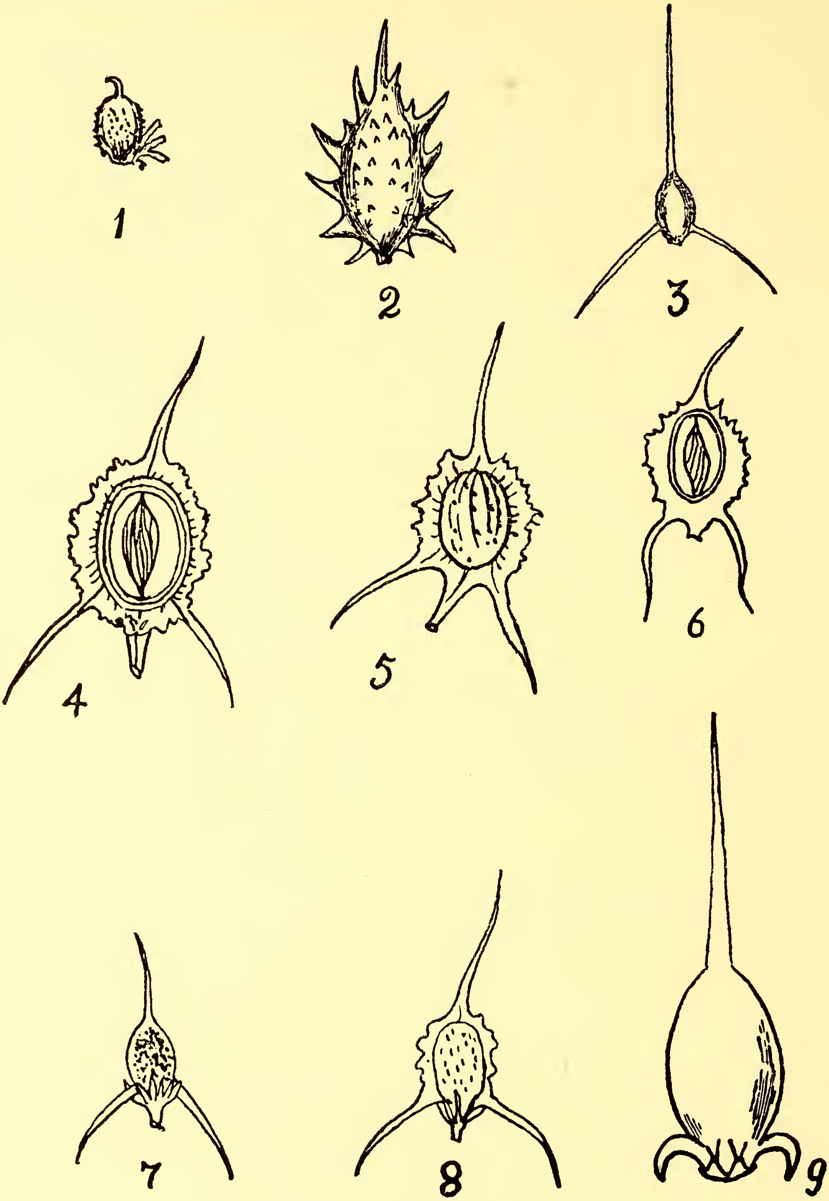
This is the second record for the Persian race of the stonechat in Arabia, Bury having previously obtained one at Majeilah, Yemen in April 1913. The summer quarters are in the Urals and Caucasus.

Corvus corax ruficollis. Brown-necked Raven.

Native name.—Ghurāb.

♂ 21 January Jabrin; ♂, ♀ 25 January Numailu; , 8 February Hadh Fāris.

As already mentioned under the Bifasciated Lark, the Raven was one of the three commonest birds seen during the journey, but even in the desert it was a difficult bird to approach. In Northern Jabrin Mr. Philby records that 'whenever the camels were turned out to graze a pair of ravens circled round them, perching now and then on their backs in search of ticks.' He attempted to secure one as a specimen 'Ali piloting me by a devious route, but the birds of this desert are mistrustful of human beings and I had to be content in the end with a distant, unsuccessful shot, after which we saw our visitors no more.' Two pairs were seen near Hadh Fāris, one in the vicinity of a new nest in which however no eggs had been laid in yet. Old nests were seen at numerous places and on January 28 three unfledged young were found at Madara. At 'Ain Sala 'a pair of ravens circled round to witness our arrival and remained in attendance, though at a discreet distance, during our sojourn of five days from February 10th to 15th'. At times however they almost forgot their fear of man and 'occasionally they even ventured into our camp during its somnolent moments.'



FIGURES COPIED FROM VARIOUS WORKS ATTRIBUTED TO *C. demersum* L.

1. *A Students' Ill. Irish Fl.* (1931), p. 19, fig. 7.
2. *Families of Flowering Plants, I. Dicotyledons* (1926), p. 95, fig. 17-c.
3. *Deutsche Fl.* (Karstens) (1880-1883), p. 581, fig. 346, 6.
4. *Icones Plantarum Indiae Orientalis*, vol. vi (1853), t. 1948, i, 11 (*C. muricatum* Cham.).
5. *Ibid.*, t. 1948, i, 9 (*C. muricatum* Cham.).
6. *Ibid.*, t. 1948, ii, 6 (*C. muricatum* Cham.).
7. *Ibid.*, t. 1948, iii, 3 (*C. tuberculatum* Cham.).
8. *Ibid.*, t. 1948, vi, 4 (*C. missionis* Wall.).
9. *Flora de Catalunya*, vol. ii, p. 352.

OBSERVATIONS ON *CERATOPHYLLUM DEMERSUM* LINN.

BY

Charles McCann, F.L.S.

(*With 2 plates and 2 text-figures*).

Introduction.

The Indian species of *Ceratophyllum* have presented many difficulties to the systematist, especially when in the shape of herbarium material which is frequently without flowers or fruit. The same is true of the genus *Ceratophyllum* in general. Hooker (11), after examining all the material at his disposal, writes: 'I have failed in establishing species amongst the dried specimens of the Indian forms of *Ceratophyllum*, but there are differences in those figured by Wight, that require to be verified by living specimens, and especially the single and bifid segments of the perianth, and the truncate and bicuspidate connective of the anthers, I find great variety in the fruit upon which species have generally been founded, but in no Indian specimens have I seen the short lateral spines which are characteristic of the European species or variety *submersum*'. Hooker considers all the Indian material as one species, namely, *C. demersum* L. and treats the species illustrated in Wight's Icones (27) as mere forms. That there is but a single species, is probably correct; I think, however, that Wight's figures do not represent forms, but certain phases in the maturation of the fruit, as I shall endeavour to explain. Cooke (5) follows Hooker in dealing with the Bombay material.

Hooker's difficulty with regard to the perianth segments and anthers can be explained. Owing to their delicate nature these characters tend to disappear in dried material, and are easily overlooked in fresh specimens. The difficulty arising from the absence of the lateral spines may be explained by the fact that Hooker had to do with either immature or damaged specimens, more likely the former. Ascherson and Graebner (2) have attempted to split the species *C. demersum* into several groups based chiefly on the characters of the fruit. My observations, however, cannot support such a division, and I totally agree with Muschler (22) that 'several species and varieties have been proposed, based on the spurs, spines, or wings of the fruit, but none of them seem to be of any value'. According to the Treasury of Botany (19) 'it varies much in the shape and excrescences of the fruit, and has been accordingly divided by some botanists into six or more supposed species, more generally considered varieties'. There has been much confusion regarding the true characters of the fruit of *C. demersum*, as will be readily seen from plate I. We have here several distinct types of fruit which are all said to be *C. demersum*, But surely, there cannot be such marked variations in the fruit of a single species?

Observation and examination of living specimens of *C. demersum* under natural and artifical conditions for a period of over a year have shown many interesting details and given satisfactory explanations for the 'errors' which have arisen with regard to the flowering and fruiting. At first I experienced extreme difficulty in determining the Bombay species owing to the meagreness of the descriptions and the discrepancies in the drawings of the fruit. My observations have led me to conclude that, (i) there is no wide variation in the form of the fruit; (ii) many important details are lost in herbarium material; and, (iii) several significant points have been overlooked by previous workers. In order to facilitate the explanation of the various items of interest I shall refer to them under their respective heads.

In conclusion I wish to express my thanks to Rev. Fr. J. F. Caius, S.J., St. Xavier's College, Bombay, for many valuable suggestions and for consulting much literature in the College Library, and to Mr. C. E. C. Fischer of Kew for copies of certain literature.

Synonymy.

Ceratophyllum demersum Linn. Sp. Pl. (1753), p. 992; Gaertn. Fruct. t. 44; Lindley Treas. Bot. (1876), p. 254; LeMaout & Decaine, Syst. Bot. (1876), p. 735; Boiss, Fl. Orient., v, 4 (1879), p. 1202; Karstens, Deut. Fl. (1880-1883), p. 581, f. 346, 6; Hook. f., Fl. Brit. Ind., v. 5 (1888), p. 639; O. Ktze., Rev. Gen. Pl., pars. ii, p. 644; Krause, Sturms Fl. v. Deut., v. 5, p. 215, f. 48; Cooke, Fl. Bom. Pres. (1907), v. 2, p. 663; Muschler, Man. Fl. Egyp., v. 1 (1912), p. 363; Merrill, Fl. Man. (1912), p. 202; Haines, Fl. Bih. & Or. (1922), p. 841; Aschn. & Graebs., Syn. d. Mitteleurop. Fl., v. 5 (1923), p. 538; Fischer, Fl. Madr. Pres., p. 1391; Herter, Fl. Uruguay (1930), v. 4, p. 61.

apiculatum Cham. in Linnaea, iv (1829), 504.

aquaticum H. C. Wats, Topogr. Bot., i, 165.

asperum Lam., Fl. Fr., ii, 196.

cornutum Reich. in Ann. Mus. Par., v, xvi (1810), 299.

cristatum Spruce ex K. Schum. in Mart. Fl. Bras., iii, 3 (1894), p. 748.

gibbum Laforet, ex Nym. Consp., 251.

missionis Wall. Cat. (1828), n. 7007; Wight & Arn., Prodr., p. 310; Wight Icon. (1853), t. 1948, f. 4.

muricatum Cham. in Linnaea (1829), v. 4, p. 405, t. 5, fig. 6-c; Wight & Arn., Prodr., p. 309; Wight Icon. (1853), t. 1948, fs. 1 and 2.

tricorne Dum., Fl. Belg., 165.

tricuspidatum Dum., Fl. Belg., 165.

tuberculatum Cham. in Linnaea, v. 4 (1829), p. 504, t. 5, f. 6-d; Wight & Arn., Prodr., p. 309; Wight Icon., t. 1948, f. 3.

unicorne Dum., Fl. Belg., 165.

verticillatum Roxb. Hort. Beng. (1814), 68; Fl. Ind., v. 3 (1832), p. 624; Trimem, Fl. Ceyl. v. 4 (1898), p. 120.

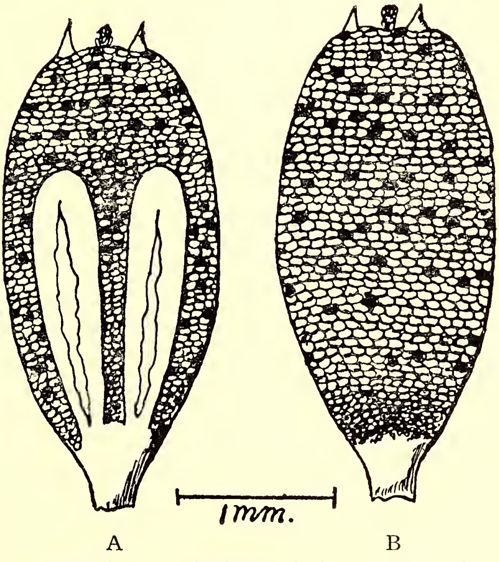
Description.

A much branched, rootless, submerged plant with stems exceeding 2 m. in length, when favourably situated. It frequently grows in pure masses.

Leaves: The leaves are arranged in whorls of 8, 5-20 cm. apart; furtherest apart on the oldest stems and branches; 1-3 times dichotomously cleft into filamentous lobes; up to 15 mm. long; stiff and brittle, minutely toothed at irregular intervals, each tooth surmounted by a sharp transparent bristle, single and groups of hairs are irregularly scattered throughout. The extremity of each segment is surmounted by two sharp bristles. The colour (a character used by some authors) is variable, pale yellowish green to dark green according to the age of the plants and the situation they are growing in. The tassels of the young leaves are usually paler, and frequently streaked with a reddish tinge. Dark green is apparent when the plant grows old or when it develops in dense shade (Pl. II, fig. 2).

Male flowers: Solitary, in separate axils to the female flowers and usually placed above them. When the plants are growing in dense masses the male flowers are irregularly placed above or below the female flowers and are only developed on the topmost branches which are near the surface of the water and exposed to the maximum of light. Involucre (Pl. II, fig. 7) composed of 6-12, narrow lanceolate 2-fid segments with a transparent glandular appendage in the sinus of the tips, somewhat longer than the depth of the sinus. The bifid nature of the segments is frequently difficult to discern as the tips stick together and are also apparently glandular. Below the tips are usually a few transparent bristles. The tips are usually lost in the herbarium (Pl. II, fig. 5).

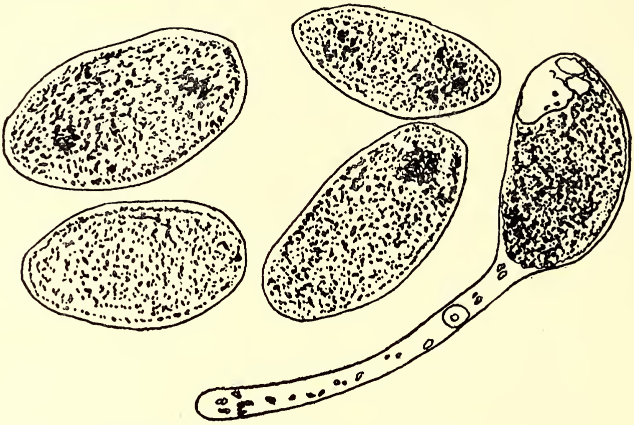
Anthers: 1·8-2·5 mm. long, ellipsoid, narrowed into the base, subsessile; apex divided into two spinous incurved processes with a short, transparent glandular process between (turning brown with age). The shape of the anthers is not always constant due to their respective positions and pressure. Anthers 8-30 in each flower, pinkish. Anther lobes 2, imbedded in spongy air-containing tissue composed of 'float' cells. Some of the cells are filled with a deep purple colouring matter giving the anthers the pink tinge when viewed by the naked eye. The lobes dehisce by longi-



Text-fig. 1.—Anthers of *C. demersum* L.

tudinal slits which are only seen on one side of the anthers, the reverse is composed of a mass of 'float' cells. The anthers always float with the lobes in contact with the surface of the water (Pl. II, fig. 6 and text-figures 1, A, B).

Pollen: Copious, colourless, ellipsoid or reniform, with motile circulating protoplasm within, giving the grains a rotary movement. The pollen tubes are sometimes developed before dehiscence of the anther lobes.

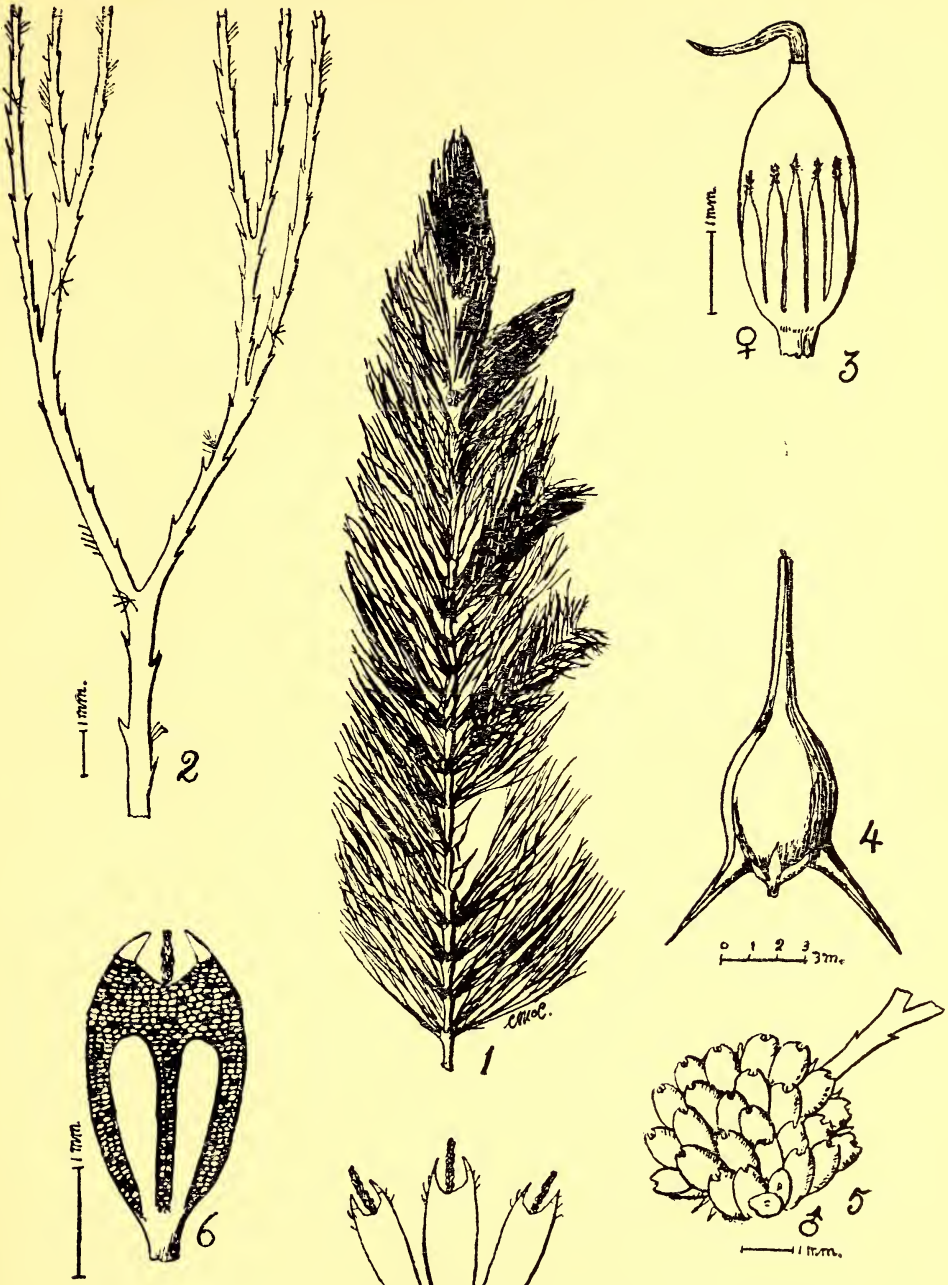


Text-fig. 2.—Pollen grains of *C. demersum* L.

Female flowers: Perianth as in the male flowers. Segments also as in the male. (Cooke (5) says not 2-fid). The tips and the glandular appendage often adhere so closely as to give a non-bifid appearance. Ovary sessile, 1-celled. Style curved as in Pl. II, fig. 3, but commences to straighten after fertilisation. The style elongates in fruit and is surrounded by a continuation of the seed coat throughout its length and eventually forming the apical spine.

Fruit: The fruit (Pl. II, fig. 4) is a small subsessile, ovoid or ellipsoid, somewhat dorso-ventrally compressed nutlet (excluding the spines). At the apex is a strong spine (already referred to) and on either side near the base are 2 lateral spines (I have obtained a specimen with 3 basal spines) tapering to a fine point, 6-7 mm. long. These spines generally grow straight (especially in plants which are not in dense masses) but occasionally may be curved, or somewhat abbreviated, possibly due to obstruction when growing densely. The fruit is covered by a thin, smooth, membranous, translucent outer coat (no tubercles or wings are present). Seed 3-4 mm. long, ovoid, slightly compressed, hard, brown, slightly longitudinally rugose along the margins or smooth. The spines are formed as a continuation of the woody seedcoat and frequently persist, but are generally broken off.

Habitat: *C. demersum* is a submerged herb of still freshwaters. It is exceedingly common throughout the islands of Bombay and Salsette, frequently associated with other aquatic vegetation, mostly *Utricularia stellaris*, but generally in almost


1
CMcC.
2
1 mm.
3
♀
1 mm
4
0 1 2 3
3m.
5
♂
1 mm.
6
1 mm.
7
1 mm.

Ceratophyllum demersum L.

1. A branch with fruit and ♂ flowers in position. 2. Leaf. 3. Young fruit. 4. Fruit. 5. ♂ flower. 6. Anther. 7. Segments of ♂ involucre.

pure societies under the shade of overhanging trees where some of the other aquatic plants cannot thrive. It may occur in deep or shallow water. In situations which dry up during the hot weather bulky masses may be found on the banks coloured greyish white owing to a large deposit of lime within the tissues. As one walks on them there is a crepitating sound like the snapping of dry sticks; and if fragments be held they feel like a heap of brittle glass fibres.

Distribution: Throughout the temperate and warmer zones of the world: Europe, Asia, North and South America, Africa and Australia.

Flowering and Fruiting: Under natural conditions, the flowering and fruiting occur in August-November; but the specimens in my aquarium also flowered and fruited in April-May and continued doing so till the beginning of the rains.

Development of the Fruit.

The young fruit is at first ellipsoid, like the ovary, without any indication of lateral spines. The style begins to straighten after fertilisation, forming the apical spine, together with the cylindric elongation of the outer coat of the fruit which gradually creeps up all round like a sheath. As growth proceeds two lateral tubercles appear on either side of the base of the fruit which finally develop into the two strong, but brittle, lateral spines. As already indicated the fruit is covered by a thin outer coat. It is this coat (pericarp) which has led to so much confusion in the diagnosis of this species. At maturity this outer coat begins to disintegrate and break up very irregularly and in different ways:—

(*a*) it may contract to form small tubercles or wrinkles giving the fruit a tuberculate or rugose appearance:

(*b*) it may split in different ways and flap over giving the fruit a 'winged' appearance as figured by Wight:

(*c*) it may split down longitudinally to one side without disintegrating; the seed escaping from the slit.

This may all happen while the fruit is still attached to the plant or after it has fallen off. At first I was inclined to believe that the wings were algae adhering to the surface of the fruit; but a careful examination soon dispelled this idea.

Considering the different modes the seed coat comes away from the seed it is not difficult to account for the discrepancies in the different drawing reproduced on Pl. I. Fig. 1 is evidently the fruit of *C. submersum* L.; fig. 2 I cannot account for; figs. 3, 7, 9 are an approach to my own drawing; figs. 4-6 undoubtedly represent fruit in which the outer coat has begun to disintegrate. Hence a division of the species on a point of 'winged fruit' falls, as also a separation based on the presence or absence of spines, which is accounted for by the age of the fruit.

The fruit when ripe generally detaches itself from the plant and being heavier than water sinks to the bottom.

Fertilisation.

Fertilisation in *C. demersum* affords curious and interesting details. The male and female flower are borne on the same branches, the males are generally protruded above the females. Neither male nor female flowers are ever produced above the surface of the water. The question naturally arises, How is fertilisation affected? Delpino (21) recognised that *Ceratophyllum* was one of the plants adapted for fertilisation under water, adding that 'these require for cross-fertilisation that the stigma or the pollen-grains, or both should be thin and filiform, and the pollen should be abundant and of like specific gravity to the water'.

The large anthers are copiously provided with 'float' cells as already indicated. They may either dehisce below the surface of the water while still on the plant, or break away from the flower in which latter case they float on the surface and then dehisce. In the latter position the anthers drift about discharging their pollen as they go. The pollen contains circulating protoplasm which gives the pollen a rotary motion. This movement is not continuous but interrupted, and gives the pollen the power of mobility. As it sinks in water, the pollen falls on stigmas situated below the male flowers, this naturally results in self-pollinisation in so much as the pollen is from the same individual as the style. However, Nature has provided for more than self-pollinisaiton. The anthers which float on the surface do so in a particular manner, with the sutures downwards. As they are blown about by winds and conveyed by water currents they shed their pollen which reaches 'foreign' stigmas, thus effecting cross-fertilisation. The subulate styles are bent over in such a way (Pl. II, fig. 3) as to offer the greatest possible surface to a 'rain' of pollen. Here we have an extraordinary adaptation of floral parts of submerged aquatic plants to ensure fertilisation.

SUMMARY.

So far as is known but a single species of *Ceratophyllum* occurs within Indian limits. The confusion which has arisen with regard to the status of the Indian species is explained by the fact that species and varieties have been based on phases of the fruit before and at the time of maturation. Another factor which has contributed largely to this misunderstanding is a reference to herbarium material which is generally imperfectly preserved. A reference to specimens preserved in formalin is always necessary when describing species of *Ceratophyllum* as the delicate portions are lost.

The fruit exhibits a series of developmental stages which have led to much confusion in the determination of the species.

Fertilisation is effected by extraordinary adaptations of the plant to pollinisation under water, particularly by floating anthers and motile pollen grains which are of the same specific gravity as water or nearly so.

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BIRDS OBSERVED AT FORT MUNRO, SULAIMAN HILLS.

BY

H. W. WAITE, M.B.O.U.

(*Indian Police*).

With Notes by HUGH WHISTLER.

Fort Munro is situated on the main Sulaiman range at an altitude of 6,300 feet, and is about 50 miles from the Indus, which here runs North and South parallel to the Range. It lies within the Punjab District of Dera Ghazi Khan and is part of the 'political area', a strip of hill territory marching with the Loralai Agency of Baluchistan and administered separately from the District proper.

The Sulaiman hills in this neighbourhood may roughly be described as sandstone with occasional outcrops of limestone. The station is a very small one, there being only about half a dozen residential bungalows, and nothing in the nature of a *bazaar*. Immediately to the west, and some 500 ft. lower, is Khar, a small, cultivated valley with a fruit and vegetable garden watered by a spring. To the East, about 300 ft. below, are two tanks known as Dames' and Trimmu, the former of which provides water for a small garden, while the latter boasts a spring from which the station obtains its drinking supply. At these tanks, and other smaller ones on the hillside, a few poplar and mulberry trees have been planted, and at Fort Munro itself partial success has attended efforts to grow the Blue Pine, Deodar, and Juniper. Otherwise the neighbourhood is bare of trees, save for an occasional stunted olive, and large areas are devoid even of bushes. Clumps of Dwarf-Palm (*Nannorhops ritchieana*) are fairly common, and here and there one comes across patches of a red-berried shrub which the Baluchis call 'pipal' and a species of *Grewia* known locally as 'kirkok'. The Oleander is found in the numerous dry water-courses, and after good rain there is everywhere an abundance of grass. The rainfall in summer is much greater than in the plains below, but even so only averages 10 ins. The winter rainfall is inconsiderable; snow falls in small quantity in some years. The night temperature in June averages 70° or under and indoors during the day is seldom much above 80°. The cold in winter is severe and aggravated by strong winds.

This portion of the Sulaiman Hills was toured in the seventies by Professor V. Ball of the Geological Survey, whose notes on birds which he observed there are to be found in *Stray Feathers* (vol. iii, p. 204). The locality is also mentioned occasionally in Ticehurst's *Birds of British Baluchistan* (*J.B.N.H.S.*, vols. xxxi and xxxii).

The following notes are based on observations made for a few days at the end of September 1930, a day at the end of the same month in the following year, and throughout June and July in 1932.

The nomenclature is that of the *Fauna of British India, Birds*, Revised Edition.

I have to thank Mr. Hugh Whistler for much help and interest in my observations and for the identification of all specimens obtained. Notes which he has kindly made are appended within brackets.

1. **Corvus corax laurencei** Hume.

Common and shares the scavenging of the place with *Neophron* and *Milvus*. When, as was usually the case, a high wind was blowing these birds would noisily chase each other and give a wonderful exhibition of aërial gymnastics.

[A pair in moult sent clearly belong to this form.]

2. **Argya caudata caudata** (Dum.)

Resident in small numbers. A nest found in a *Grewia* bush on 4th July contained two hard-set eggs.

[Two males, wings 83 and 85 mm., are very close indeed to *A. c. eclipes* in colour and go better with that form than with the typical race.]

3. **Molpastes leucogenys leucotis** (Gould).

Present in small numbers in the gardens and their immediate neighbourhood. A nest found in a Pine tree on 4th June contained three slightly incubated eggs.

4. **Oenanthe picata** (Blyth).

Abundant in June, when numbers of young birds were still being fed by their parents, largely on *Grewia* berries and those of the '*pipal*' shrub. Practically all specimens obtained, both adult and juvenile, were infested with ticks about the head and neck. A nest still occupied was found on 7th June. This was situated on a beam in the verandah roof of an empty bungalow and consisted of a shallow pad of grass on a substantial foundation of stone chips. The chips averaged about the size of a rupee and had evidently been carried up by the birds. There were three callow young in the nest, one of them dead but showing no signs of decomposition. Several old nests were discovered in holes in walls, rocks, and boulders, and in every case a similar foundation of stone chips had been provided.

By the middle of July there was a marked decline in the number of these birds, which had presumably started moving down to the plains. Odd birds were met with at the end of September. *Œnanthe capistrata* was not seen on any of my visits.

[Ticehurst informs us that the first birds reach Sind in July (*J.B.N.H.S.*, xxxi, 707) and I met the first male in Jhang District in 1919 on 2nd August, so it is evident that the decline in numbers noted at Fort Munro by the middle of July really represented the starting of the Autumn migration.]

5. **Oenanthe opisitholeuca** (Strickl.).

Adults and young birds were fairly frequently met with in June on the same ground as *picata*, but their number was markedly less. They disappeared at the beginning of July, and I did not observe any after the 4th of that month. Doubtless some of the old nests seen belonged to this species.

[My earliest dates for the Punjab are August 15, 1915, at Gujranwala, August 16, 1918, at Lalian, Jhang District, and August 15, 1919, at Jhang-Maghiana].

6. **Saxicoloides fulicata cambaiensis** (Lath.).

Apparently rare at Fort Munro. Only observed on two occasions, on 7th June (two males) and 4th July (one male). No specimen secured.

7. **Monticola solitaria longirostris** (Blyth).

Single birds were met with on four occasions at the end of June. All were juveniles. Not noted in September.

[These juveniles, all apparently males, have the wings respectively 121, 123·5, 125 and 125·5. They clearly differ from juveniles of *M. s. pandoo* in being much paler, both above and below, and in having heavier beaks.]

8. **Muscicapa striata neumanni** Poche.

Common on passage in September.

9. **Siphia parva parva** (Bechst.).

A few were met with on passage in September.

10. **Tchitrea paradisi leucogaster** (Swains.).

A male in chestnut plumage was obtained in the garden at Khar on 24th September 1931. This was the only one seen.

11. **Lanius vittatus** Valenc.

Common in June and July. Young birds were about in the middle of June. A nest found on 13th June in a Deodar in the compound of an unoccupied bungalow contained three slightly incubated eggs. Another nest in an olive tree by the road-side held two fresh eggs on 26th June.

12. **Lanius cristatus phoenicuroides** Severtz.

A juvenile was obtained on 23rd September, 1931. No others seen.

[A migrant on its way to Africa by the Arabian route. It passes through Sind in small numbers from mid-September to mid-October (Ibis 1922, p. 609).]

13. **Agrobates galactotes familiaris** (Ménét.).

The only one seen was obtained on 1st August, 1932.

[Also a migrant to Africa by the Arabian route. Ticehurst found in Sind that its passage lasted for but a short time, 3rd to 24th September. The earliest date for the Quetta Valley is 30th July.]

14. **Acrocephalus dumetorum** Blyth.

One was obtained at Khar on 1st August, 1932.

15. **Hippolais rama rama** (Sykes).

Sparingly met with on passage towards the end of July.

16. **Sylvia hortensis jerdoni** Blyth.

Observed on three occasions, on 26th June (a juvenile), 14th July, and 22nd July.

17. **Sylvia althaea** Hume.

The only one seen was obtained on 21st July.

18. **Sylvia curruca affinis** Blyth.

One was obtained on passage on 25th September, 1930.

19. **Acanthopneuste nitidus nitidus** Blyth.

One was obtained in the garden at Khar on 28th July, 1932. Common on passage in September.

20. **Scotocerca inquieta striata** (Brooks).

A pair was obtained on 9th June. These were the only ones met with.

21. **Suya criniger striatula** (Hume).

Abundant in June and July, when its monotonous 'song' was to be heard on all sides. The organs of specimens obtained were in breeding condition, but only one nest was found. This appeared to be ready for eggs on 18th June, but was subsequently deserted. Seldom seen in September.

22. **Pastor roseus** (L.).

First appeared on the Autumn passage on 27th June, when a fair-sized flock was found resting in some pine trees, and a few were seen about the hill on the two following days. On 5th July numbers were observed in a fruit garden on the Rakhni plain (Loralai) below Khar, where they were attacking the grapes. From the 14th until the end of the month numerous flocks passed over Fort Munro every morning from West to East. They were swarming on the date palms and devouring the ripe fruit when I passed through the Muzaffargarh District on 4th August.

23. **Uroloncha malabarica** L.

Not seen at Fort Munro, but two were obtained at Khar on 28th July. These Munias were exceedingly numerous in a fruit garden at Rakhni on 5th July.

24. **Passer domesticus** sub-sp.?

Common on each of my visits, nesting in buildings in June and July. Very partial to the fruit of the few mulberry trees in the place.

[The two males measured, wings 75 and 75·5 mm., can only be attributed to the race *indicus*, to which also I should therefore attribute two males from Loralai with wings of 77 mm.]

25. **Emberiza stewarti** Blyth.

Met with in small numbers at Fort Munro and the garden at Khar in September.

26. **Emberiza bruniceps** Brandt.

A small party of what appeared to be Red-headed Buntings rested in a bush a few yards from me on 23rd July, but were off again before I had time to secure a specimen.

27. **Emberiza striolata striolata** (Licht.).

First seen on 18th July when a male appeared in the compound of my bungalow. By the end of the month these birds had become fairly common, and their cheery little 'song' was frequently to be heard on the hill-sides. The testes of males obtained were greatly enlarged.

28. **Krimnochelidon obsoleta pallida** Hume.

Observed from time to time, singly or in pairs, throughout June and July. From the organs of specimens obtained they appeared to be breeding, but I failed to find any nests. Noted as common in September, occasionally nesting on the roof cornices of buildings.

[These birds seem to bleach rapidly and most skins in collections are poorly made and greasy. From the series I have been able to examine I am by no means satisfied that birds from the north-west frontiers of India are separable from those of north-east Africa.]

29. **Hirundo daurica scullii** Seebohm.

Common in June and July, nesting in the roofs of bungalow verandahs and out-houses. Slightly incubated eggs were taken on 13th June, 14th July, and 2nd August, the clutch numbering two or three. Nests broken open were repaired and more eggs laid. Not noted in September. 5 specimens were obtained and are those referred to by Ticehurst in his note on this bird (*Ibis* 1933, p. 547).

30. **Motacilla cinerea caspica** S. G. Gmelin.

A few were observed in the neighbourhood of the tanks in September. A solitary wagtail seen in a torrent bed on 24th July was almost certainly of this species.

31. **Anthus trivialis trivialis** (L.).

A few were met with on passage in September.

32. **Anthus sordidus decaptus** Meinertzhagen.

Common on each of my visits. Nests were found with two downy young on 3rd June, c/3 hard-set on 4th June and c/3 hard-set on 18th June. Many young birds were seen throughout June and July.

33. **Oreocorys sylvanus** (Hodgs.).

Only met with on the northern face of a steep hill immediately to the West of Fort Munro. A juvenile was secured at the end of June and three adults in the first-half of July, one unsexed and the other two males with organs in breeding condition. The curious call was usually uttered from the tops of large boulders and was very difficult to locate.

[A welcome record as very little is known of this species in this area. The adults sent appear somewhat paler than Himalayan birds but they are very worn and this may be only due to bleaching.]

34. **Galerida cristata magna** Hume.

Observed occasionally on each of my visits. Adults were seen feeding young birds at the beginning of June.

[Four adult males obtained at Fort Munro are definitely assignable to this race with wing measurements 108-114 mm. It is interesting to note, however, that two other males from Badin, Loralai Agency, are smaller, wings 105.5-106 mm.]

35. **Ammomanes deserti phoenicuroides** (Blyth).

Observed occasionally on each of my visits. Young birds were met with in June and an adult was seen carrying food on the 6th of that month.

[Two adult ♂s have the wings 101·5 and 106 mm. respectively, showing that these birds are typical *phoenicuroides*, like the Sibi, Bolan Pass and Fort Sandeman birds mentioned by Ticehurst (*J.B.N.H.S.*, xxxi, 876). The two juveniles have the longer, broader and blunter first primary than the adult as noted by Ticehurst (*Ibis* 1923, p. 20). In colour they agree with adults, but the feathers of the upper parts show indistinct subterminal dark bars and pale tips. The primary and greater coverts, the wing and tail quills have the pale edges broader than in adults and more rufous in colour.]

36. **Leptocoma asiatica brevirostris** (Blanf.).

Only once observed at Fort Munro, a female on 18th July. A pair was seen in a fruit garden on the Rakhni plain on 5th July.

37. **Coracias garrula semenowi** Loud and Tschusi.

Appeared on passage at the end of July when one or two were seen at Fort Munro and Khar.

38. **Upupa epops epops** L.

A few were met with at Fort Munro and Khar at the end of July.

39. **Micropus melba melba** (L.).

Two or three were seen hawking in company with *Hirundo daurica* on 21st, 25th and 28th July and 2nd August. Not noted in September. No specimen obtained.

40. **Micropus affinis galilegensis** (Ant.).

A few were observed in company with *Hirundo daurica* on two occasions in the middle of July and again at the beginning of August. Not noted in September.

[The single ♂ obtained, wing 132, evidently belongs to this race.]

41. **Caprimulgus europaeus unwini,** Hume.

Throughout the latter half of June two or three of these Nightjars were to be seen regularly at dusk hawking in the vicinity of the bungalows. One was shot on 28th June.

[An unusually silvery specimen compared with the majority of examples of this form.]

42. **Aegypius monachus** (L.).

A pair of very dark vultures seen on 12th June were possibly of this species.

43. **Gyps** sp.?

Griffons of sorts were noted on three occasions in June.

44. **Pseudogyps bengalensis** (Gm.).

Twice seen in June, once in a party of about half a dozen.

45. **Neophron percnopterus percnopterus** (L.).

Common on each of my visits. It presumably breeds in the cliffs round about and a number of young birds were noted.

46. **Gypaetus barbatus hemachalanus** Storr.

One or more of these grand birds were frequently observed throughout June and July, often flying quite low over the hill-side and coming within a few yards of one.

47. **Cerchneis tinnunculus** sub-sp.?

A pair of Kestrels was observed, either singly or together, almost daily throughout June and again at the end of July, occasionally being mobbed by Ravens. Several were met with in the garden at Khar in September, when a male was secured.

[This male, wing 249 mm., is a very pale immature bird but I should not like to say to what race it belongs. See *Ibis* 1923, p. 261.]

48. **Aquila heliaca heliaca** (Savigny).

An eagle seen perched on a large boulder at the end of July was possibly a young bird of this species.

49. **Milvus migrans govinda** Sykes.

One or more of these kites were scavenging round the hill throughout June and July.

50. **Accipiter nisus melanoschistus** Hume.

Only met with once, on 24th September, 1930, when a female was shot in a small plantation of pines near Dames' tank.

51. **Streptopelia senegalensis cambayensis** (Gmel.).

A few pairs were constantly met with throughout June and July. This Dove and *S. d. decaocto* were common on the Rakhni plain in June, but the latter apparently does not ascend to Fort Munro.

[Two males collected at Fort Munro and Badin, Loralai, have the wings respectively 130 and 131·5 mm.]

52. **Coturnix coturnix coturnix** (L.).

One was flushed from the hill-side on 17th June. I had previously put one up from the bank of a stream on the Rakhni plain on the 12th.

53. **Alectoris graeca** sub-sp.?

A small covey was seen on two occasions at the end of June and a pair on the 15th July, but I did not succeed in obtaining a specimen.

54. **Francolinus pondicerianus** sub-sp.?

Grey Partridges were heard calling round Khar in June and July. Several were seen by the road-side when motoring over the Rakhni plain in June. No specimen obtained.

55. **Tringa ochropus** L.

What appeared to be a Green Sandpiper was noticed at one of the tanks on the 12th July, but it flew off before I got near and was not seen again.

56. **Tringa hypoleucos** L.

A party of three was found on one of the tanks on 24th July. They were extremely wild, and I with difficulty secured a female, which was loaded with fat.

57. **Lobipes lobatus** (L.).

A small flock was met with on Trimmu tank on 25th September, 1930. They were remarkably tame and showed little signs of alarm even after a pair had been shot.

NOTE ON A PYRALID (*ARGYRIA FUSCIVENALIS* Hmp.), CATERPILLAR PEST OF *CRATAEVA RELIGIOSA* Forst.

BY

M. C. CHERIAN, B.A., B.SC., D.I.C.

(*Lecturer in Entomology, Agricultural College, Coimbatore*).

(*With a plate*).

Introduction.—The present paper deals with *Argyria fuscivenalis*, Hmp., a serious pest of *Crataeva religiosa*, Forst., an ornamental tree found in Coimbatore and its environs. An account is given of the life history and habits of this insect together with the control methods for the same.

Life history.—The adult moths (Fig. 7) measure 6 mm. long with a wing expanse of 13 mm. They have pale yellow forewings and pale white hind wings. There are two dark wavy lines on each of the forewings. The adults have got the peculiar habit of resting on leaves with their heads directed downwards. Moths kept in captivity were found to feed freely on jaggery water. Longevity records of the moths (Table I) show that one moth topped the list with 24 days while the average period for 23 moths was 12 days.

Eggs are generally laid 2 days after the emergence of moths. One female laid as many as 225 eggs in 11 days (Table II). For egg laying the female prefers infested leaves (Fig. 1) with webs on them. Eggs are either laid on these webs or on portions of leaves from which the green matter has been scraped off by young caterpillars. The newly laid eggs (Fig. 2) are pale yellow in colour and roughly oval in shape measuring 0·5 mm. long. On the second day the colour of the egg changes and three transverse bars (Fig. 3) pinkish in colour are noticed on the egg. The egg period is 3 to 4 days.

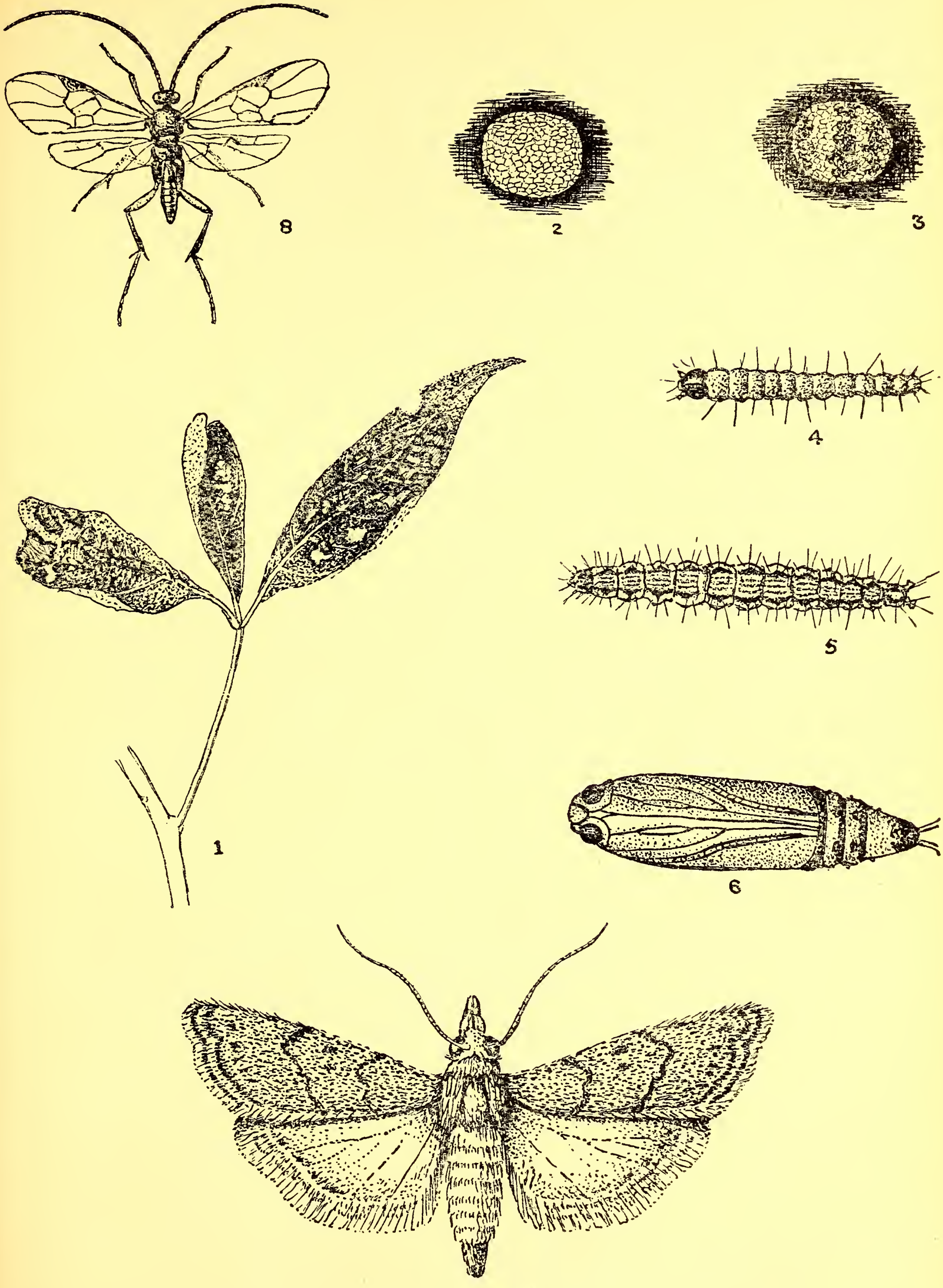
The newly hatched larvae (Fig. 4) are 1 mm. long and 0·2 mm. broad, pale yellow in colour with black head capsule and white hairs all over the body. They begin to make webs and feed under cover of these and undergo four months in all before pupation (Table III). When they are full fed (Fig. 5) they measure about 3 mm. long and 2 mm. broad and have two dorsal longitudinal lines of violet colour. On every segment are seen triangular black spots with their bases touching the lines. White hairs are also seen on the body. The larval period is 12-13 days.

The caterpillars when full fed make silken cocoons and pupate inside hese. The pupae (Fig. 6) are deep brown in colour and measure about mm. long and 2 mm. broad. The pupal period is 9-10 days.

The whole life cycle lasts 23-27 days (Table IV).

Parasites.—Three parasites have been noticed on the caterpillars one of which is *Apanteles creatonot* (Fig. 8) and the other two *Heterogamus* sp. and un unidentified Ichneumonid. These however are not found in large numbers as to check the pest.

Remedial measures.—Spraying with Lead arsenate at the rate of half an ounce to one gallon of water has been found to be useful against the pest. In the case of small trees hand picking of the caterpillars may be tried with advantage.



Argyria fuscivenalis, Hmp.

1. *Crataeva religiosa* (attacked leaf).
2. Egg (newly laid).
3. Egg (second day).
4. Young caterpillar.
5. Full grown caterpillar.
6. Pupa.
7. Adult moth.
8. Parasite.

TABLE I.

Longevity records of adults.

No.	No. of moths.	Emerged.	Died.	Total No. of days alive.	Remarks.
1	1	25- 7-27	18- 8-27	24	
2	2	26- 7-27	16- 8-27 18- 8-27	21 23	♂ ♂
3	2	27- 7-27	6- 8-27 9- 8-27	10 13	
4	2	29- 7-27	3- 8-27 6- 8-27	5 8	 ♀
5	2	1- 8-27	10- 8-27 12- 8-27	9 11	
6	1	23- 9-27	9-10-27	16	♀
7	2	23- 9-27	5-10-27 8-10-27	12 15	♂ ♀
8	1	27- 9-27	3-10-27	6	♀
9	1	17-10-27	24-10-27	7	♀
10	1	19-10-27	25-10-27	6	
11	1	20-10-27	10-11-27	21	♂
12	1	20-10-27	2-11-27	13	♂
13	1	21-10-27	12-11-27	22	♀
14	1	15-11-27	25-11-27	10	♀
15	1	16-11-27	25-11-27	9	♂
16	1	17-11-27	24-11-27	7	♀
17	1	17-11-27	24-11-27	7	♀
18	1	18-11-27	25-11-27	7	♀

TABLE II.

Egg-laying record of a female moth.

Date		No. of eggs
23- 9-27	...	♂ & ♀ emerged and kept for egg laying.
25- 9-27	...	2 eggs.
26- 9-27	...	42 ,,
27- 9-27	...	15 ,,
28- 9-27	...	19 ,,
29- 9-27	...	16 ,,
30- 9-27	...	55 ,,*
1-10-27	...	34 ,,
2 & 3-10-27	...	27 ,,
4-10-27	...	6 ,,
5-10-27	...	9 ,, (♂ died).
8-10-27	...	♀ died.
Total No. of eggs	...	225

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* Of this number only 18 were freshly laid eggs while 37 found on the cotton wool placed in the rearing jars may have been laid probably two or three days previously.

TABLE III.

Records of detailed life history observations.

Particulars.	A	B	C
Egg found laid	26-9-27	22-10-27	22-10-27
Egg found hatched	29-9-27	25-10-27	25-10-27
Moulted I	1-10-27	27-10-27	27-10-27
Moulted II	3-10-27	29-10-27	29-10-27
Moulted III	5-10-27	31-10-27	31-10-27
Moulted IV	7-10-27	2-11-27	2-11-27
Cocooning	10-10-27	4-11-27	5-11-27
Pupated	12-10-27	6-11-27	8-11-27
Adult emerged	20-10-27	16-11-27	17-11-27
Total life cycle ...	24 days	25 days	26 days
Sex ...	♀	♂	♀

TABLE IV.

Table of life history records.

Serial number.	Egg found laid.	Egg found hatched.	Duration of egg period in days.	Date of cocooning.	Duration of active larval life in days.	Found pupated.	Duration of larval period in days.	Adult emerged.	Duration of pupal period in days.	Total life cycle in days.	Sex.
1	26-9-27	29-9-27	3	10-10-27	11	12-10-27	13	20-10-27	8	24	♀
2	,,	,,	3	,,	11	,,	13	,,	8	24	♂
3	,,	,,	3	,,	11	,,	13	,,	8	24	♂
4	,,	,,	3	,,	11	,,	13	,,	8	24	♂
5	,,	,,	3	,,	11	,,	13	21-10-27	9	25	♀
6	,,	,,	3	,,	11	,,	13	19-10-27	7	23	...
7	22-10-27	25-10-27	3	7-11-27	13	...	...	18-11-27	...	27	♀
8	,,	,,	3	4-11-27	10	6-11-27	12	16-11-27	10	25	♂
9	,,	,,	3	5-11-27	11	8-11-27	14	17-11-27	9	26	♀
10	,,	,,	3	4-11-27	10	6-11-27	12	15-11-27	9	24	♀
11	,,	,,	3	5-11-27	11	8-11-27	14	17-11-27	9	26	♀

NOTES ON SOME SOUTH INDIAN SYRPHIDS.

BY

M. C. Cherian, B.A., B.Sc., D.I.C.

(*Lecturer in Entomology, Agricultural College, Coimbatore*).

Introduction.—Syrphids, commonly known as 'Hover flies' or 'Sun flies', play an important part in checking one of the worst insect pests of cultivated crops, viz., Aphids and as such these are very valuable to the farmer. Along with Lady birds (*Coccinellidae*), Lace wings (*Chrysopidae*) and Leucopis flies (*Argomyzidae*) these prey upon Aphids and destroy them in numbers. Though in other countries a few have been noted as pests yet in India this has not been the case. The present paper is an attempt to bring together information regarding the distribution of species, hosts etc. of the South Indian forms. The description and life history notes are the writer's own but information gathered from the labels of the Coimbatore collections while the writer was the Assistant Entomologist has also been included. The thanks of the writer are due to the Director, Imperial Institute of Entomology, London, for identifying some of the specimens included in the list.

Description of Adults and General Life History.—Adult flies are generally brightly coloured with bands of yellow and black predominating. This colouring gives them the resemblance to wasps. The 'false vein' is an important character of the family. While the adult flies feed on the nectar of flowers the maggots have varied habits. Some of these are predaceous on Aphids; others are found living in decaying organic matter and yet a third group consists of plant feeders.

Classification.—The classification followed is that adopted by Verrall and used by Brunetti in the Fauna of British India series. Of the seven sub-families included in the Fauna viz., *Syrphinae*, *Eristalinae*, *Milesiinae*, *Chrysotoxinae*, *Volucellinae*, *Microdontinae* and *Ceriinae*, the first four alone are represented in the list. The various Syrphids met with in South India are arranged under their respective sub-families.

SUB-FAMILY: SYRPHINAE.

1. *Paragus serratus*, Fabr.

Reference.—Brunetti, *Fauna of British India*, *Diptera*, vol. iii, p. 31.

Life history and habits.—Eggs are laid by female flies on plants infested with Aphids. These are white and oval and measure about 0.75 mm. long. The newly hatched maggots have stiff black hairs all over the body. They feed on Aphids by sucking out their body contents. The maggots are known to attack both root and shoot infesting aphids. In the case of those feeding on root infesting forms the colour of the maggot is generally pale white. Those which feed on Aphids on shoots have generally bright colours. The pupae, about 5.5 mm. long, are found on the leaves. The pupal period lasts 7 to 8 days. The longevity of two adults fed on jaggery-water in captivity came to 5 and 11 days respectively.

Food.—Maggots have been noted feeding on Aphids on *Cholam* and *Ragi* both on the shoot and root forms. Also on Aphids on Sweet potato and water melon.

Distribution.—The Coimbatore collection contains specimens from Coimbatore; Hadagalle (Bellary); Samalkota (Godavari) and Ramnad.

Remarks.—This is a common species found in Coimbatore along with *Ischiodon scutellaris*. The presence of the serrated scutellum is one of the most important characters of the fly.

2. *Ischiodon scutellaris*, Fabr.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 97.
Lefroy, *Indian Insect Life*, Plate lxiv, p. 611.
Fletcher, *Some South Indian Insects*, Plate xv, p. 358.

Life history and habits.—The habits are similar to those of Paragus. Two forms of maggots noticed are those with green colour and those with bright colours. The latter look like those of Paragus but the brightly coloured transverse bar about the middle of the body found in Paragus is absent. The larval period is about 5 days and the pupal period about 5 to 6 days. The maximum longevity in the case of a fly fed with jaggery water in captivity came to 17 days. Three females laid 154 eggs between them.

Food.—Maggots have been noted feeding on Aphids on red gram, cholam, Calotropis sp., water melon and cotton. Adult flies have also been collected resting on brinjal, mustard, turnip, cabbage and groundnut.

Distribution.—Coimbatore; Marudamalai (Coimbatore); Hagari (Bellary); Kallar (Nilgiris); Saidapet (Chingleput); Samalkota (Godavari); Villupuram (South Arcot).

Remarks.—The presence of a slender tooth on the under surface of the hind trochanter is an important mark of the species.

3. *Asarcina aegrota*, F.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 64.

Food.—Maggots were found feeding on the dark brown Aphids on citrus.

Distribution.—Coimbatore.

4. *Asarcina ericetorum*, Fabr.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 63.

Food.—Adults found resting on cholam leaves.

Distribution.—South Canara; Coimbatore; Bellary; Godavari; Chepauk (Madras).

5. *Syrphus balteatus*, De Geer.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 82.

Food.—Maggots found feeding on Aphids on *Arundo donax* and certain grasses.

Distribution.—Salem; South Canara; Coimbatore; Malabar; Kallar (Nilgiri Hills); Yercaud (Salem) and Maruthamalai (Coimbatore).

6. *Sphaerophoria javana*, Wied.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 100.

Distribution.—Maruthamalai (Coimbatore).

7. *Baccha nubilipennis*, Aust.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 116.

Distribution.—South Canara.

8. *Baccha triangulifera*, Aust.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 124.

Distribution.—South Canara.

9. *Baccha sapphirina*, Wied.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 122.

Food.—Predaceous on Psyllid bugs.

Distribution.—Coimbatore.

SUB-FAMILY: ERISTALINAE.

10. *Eristalis arvorum*, Fabr.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 181.

Distribution.—Coimbatore; Devakonda (Kurnool); Hadagalle (Bellary); Amalapuram (Godavari); Madanapalle (Chittoor).

11. *Eristalis multifarius*, Walk.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 194.

Distribution.—Coimbatore.

12. *Eristalis laetus*, Wied.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 165.
Distribution.—Bababudin hills (Mysore).

13. *Eristalis obscuritarsis*, deMeij.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 190.
Distribution.—Kurnool.

14. *Eristalis quinquestriatus*, Fabr.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 187.
Distribution.—Bababudin hills (Mysore).

15. *Eristalis quinquelineatus*, Fabr.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 183.
Distribution: Yercaud (Salem).

16. *Megaspis crassus*, Fabr.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 197.
Food.—Flies collected resting on safflower.
Distribution.—Coimbatore; Kurnool; Amalapuram (Godavari); Saidapet (Chingleput).
Remarks.—A tooth on the hind femora is an important mark of the species.

17. *Megaspis errans*, Fabr.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 199.
Food.—Adults collected resting on manure heap, safflower, cholam and sugarcane.
Distribution.—Coimbatore; Amalapuram (Godavari); Hadagalle (Bellary); Devakonda (Kurnool); Madanapalle (Chittoor).

18. *Megaspis argyrocephalus*, Macq.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 201.
Distribution.—Coimbatore.

SUB-FAMILY: MILESIINAE.

19. *Xylota bistriata*, Brun.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 238.
Food.—Adults collected resting on coffee flowers.
Distribution.—North Coorg.

20. *Xylota carbonaria*, Brun.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 240.
Distribution.—Yercaud (Salem).

21. *Syritta rufifacis*, Big.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 247.
Food.—Maggots found feeding on Aphids on mango flowers.
Distribution: Coimbatore.

22. *Syritta pipiens*, L.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 245.
Food.—Maggots in rotting paddy, rotting ash gourd.
Distribution.—Coimbatore; Bellary; Madanapalle (Chittoor).

23. *Eumerus albifrons*. Walk.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 257.
Food.—Adults resting on castor and water melon leaves.
Distribution.—Salem; Coimbatore.

SUB-FAMILY: CHRYSOTOXINAE.

24. *Chrysotoxum baphyrus*, Walk.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 296.
Distribution.—Yercaud (Shevroys).

AN ANNOTATED LIST OF INDO-CEYLONESE TERMITES

BY

V. MARGABANDHU, M.A.

(*Assistant to Government Entomologist, Coimbatore*).

The Termites or 'white ants' are a group of insects which have not received enough attention during recent years. They are of great economic importance, in view of their ravages to wooden structures, cotton and woollen clothings, books, etc., not to speak of their damage to cultivated crops such as sugarcane, tea, wheat etc.

The earliest known observations on termites were made on South Indian termites by Koenig about 150 years ago, which centred about Tanjore and Nagari hills.[1] He has given an anatomical account of the different castes and has made mention of *Hodotermes viarum* Koenig, *Termes convulsionarius* Koenig and a species of *Eutermes* which, according to him, is similar to the one noted by him in Ceylon later. In this connecton, Fletcher is of opinion that the species Koenig refers to as *Eutermes monoceros*,—the 'black termite' of Ceylon, is different and the latter has not been recorded in India. Since that time collections were made by several and specimens were sent outside for identification. Father Assmuth from Bombay sent collections to Dr. Holmgren of Stockholm with very interesting observations and the results were published in the Bombay Journal.[2] The same writer has also published an account on the wood destroying white ants in the same journal.[3] In South India impetus to the study of white ants was given by Mr. Bainbrigge Fletcher whose keen interest on this group of insects is well known; and a good collection of termites of South India was made by him and sent to Dr. Holmgren, the results of which have found a place in one of the Pusa Memoirs.[4] Late Dr. Annandale of the Indian Zoological Survey collected some material from the Barkuda Island, Chilka Lake and the material was examined by Silvestri and recorded in the Records of the Indian Museum.[5] In addition to these, there are several earlier records of Indian termites by Desneaux, Wasmann and others.

The classification adopted in this list is that of Dr. Holmgren which is so far the simplest in the present state of our knowledge of the Indo-Ceylonese forms. The oldest classification has been retained in order to avoid confusion, as the classification of this group requires careful handling. It is the considered opinion of the writer that the classification may be changed as more and more material of the different forms are examined and studied.

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[1] Koenig, 1779, Naturgeschichte der sogenannte weissen Ameisen; Besch. der Berlin. Ges. naturforsch. Freunde, T. iv, pp. 1-28.

[2] Holmgren, N., 1912, *J. Bomb. Nat. Hist. Soc.*, xxi, 774-793.
1913, *J. Bomb. Nat. Hist. Soc.*, xxii, 101-117.

[3] Assmuth, A. J., 1913, *J. Bomb. Nat. Hist. Soc.*, xxii, 372-384.
1915, *J. Bomb. Nat. Hist. Soc.*, xxiii, 690-694.

[4] Holmgren, N., 1917, *Mem. Dept. Agr. India*, Ent. Ser. v, 138-171.

[5] Silvestri, F., 1923, *Rec. Ind. Mus.*, xxv, 221-232.

Some years back, the writer had occasion to deal with termites that cause damage to sugarcane and in that connection undertook a study of this group since then. As time permitted, the available literature has been gathered and the known species have been arranged in the form of a list in the hope that this will form a basis for study to those interested in this highly economic group. It is with this object this list has been prepared. In so doing, it is not presumed that this is a complete one. It cannot but have several drawbacks as most of the literature is in foreign languages and not easily accessible.

A study of the termite fauna of India will not be complete unless a study of the Ceylonese forms is also made and with this object Indo-Ceylonese forms have been given in this list. The writer had to depend mainly on Mr. Green's catalogue of Ceylonese forms.[1]

In order that the list may be of some use and to make it interesting, instead of making it merely bibliographical, such useful information as the nature of damage they cause, the localities where they were recorded and observations made by collectors and any additional information which may be of systematic importance have also been given.

The writer wishes to express his thanks to Rao Sahib Y. Ramachandra Rao, now Locust Research Entomologist, for having given him an opportunity to study these insects and to Dr. T. V. Ramakrishna Ayyar, Government Entomologist, Coimbatore, for affording all facilities in the continuance of this study and for going through the manuscript.

ORDER: ISOPTERA.

FAMILY: *PROTERMITIDAE*, HOLMGREN.

SUB-FAMILY: HODOTERMITINAE, Holmgren.

Hodotermes, Hagen.

Hodotermes viarum, Koenig, Fletcher, Bull. Dept. Agr. India, No. 100, p. 246 (1921). 'Commonly occurring at Coimbatore doing some damage to grass lawns by cutting off grass.'

Sub-genus: *Acanthotermes*, Sjost.

Hodotermes (*Aacnthotermes*) *koenegi*, Holmgren, Mem. Dept. Agr. India, Ser. v, No. 3, pp. 138-139 (August 1917). Species described and recorded from Coimbatore, South India. 'Extracted from tunnels in the ground.'

Hodotermes (*Acanthotermes*) *macrocephalus*, Desneaux, Ann. Soc. Ent. Belgique, xlix, pp. 344-348 (1905). Species described and recorded from Sind, India; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 139 (August 1917). Also recorded from Sind, India.

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[1] Green, E. E., 1913, *Spolia Zeylanica*, *Ceylon*, ix, 7-15.

SUB-FAMILY: CALOTERMITINAE, Holmgren.

Calotermes, Hagen.

Calotermes domesticus, Haviland, Jl. Linn. Soc. London, xxvi, p. 374 (1898); Green, Spolia Zeylanica, ix, pt. xxxiii, p. 8 (June 1913). 'In window and door frames of buildings, in furniture, shelves of almirahs etc. The presence of this species is indicated by small heaps of egg-like pellets of excreta which collect below the articles that contain the termites. Occasionally the insects emerge from the wood and are found congregated in masses in the open.' Recorded from Peradeniya, Ceylon.

Calotermes greeni, Deseneaux, Ann. Soc. Ent. Belgique, li, pp. 388-389 (1907). Species described; Green, Spolia Zeylanica, ix, pt. xxxiii, p. 8 (June 1913). Green records in stems of living tea bushes, in stems of *Anacardium* and other trees, occurring more commonly at lower elevations, from Ambalangoda, Kalutara, Yatiyantota, Jaffna, and from Peradeniya in Ceylon; Hutson, Tropical Agriculturist, lix, pp. 83-87 (February 1923). Notes on termites attacking tea and their control are given. Recorded from Ceylon; Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 382-383 (1926). Briefly described and recorded from dead stems of Grevillea, stem and roots of tea, and living tea bush, from Ceylon; Jepson, Tropical Agriculturist, lxvii, pp. 77-78 (August 1926). Deals with the control of the insect attacking tea bushes along with *C. militaris* in Ceylon; Dept. of Agriculture, Ceylon, Leaflet No. 24, giving notes on termites attacking tea, their habits and control, recorded from Ceylon.

Sub-genus: *Glyptotermes*, Froggatt.

Calotermes (Glyptotermes) ceylonicus, Holmgren, Escherich's Termitenleben auf Ceylon, p. 189 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 8 (June 1913). 'In decaying logs and branches.' Recorded from Peradeniya, Ceylon; Holmgren, Spolia Zeylanica, viii, pt. 32, pp. 279-280 (January 1913). Imago and soldiers described. Imagines of *C. ceylonicus* and *C. dilatatus* compared. Also recorded from Peradeniya.

Calotermes (Glyptotermes) coorgensis, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 139-140 (August 1917). 'Tunnelling in the still solid wood of an old log of red cedar.' Recorded from Coorg, Sidapur, 3,500 ft., India.

Calotermes (Glyptotermes) dilatatus, Bugnion & Popoff. Bugnion, Mem. Soc. Zool. France, xxiii, pp. 137-143 (1910). Describes and figures as found in a tea stump at Ambalangoda, Ceylon; Holmgren, Spolia Zeylanica, viii, pt. 32, p. 278 (January 1913). Imago described from Peradeniya; Hutson, Tropical Agriculturist, lix, pp. 83-87 (February 1923). Notes on termites attacking tea and their control are given. Also recorded from Ceylon; Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 383-384 (1926). Species briefly described. Recorded from Ceylon, found in living tea bush, stem and roots of tea; Jepson, Tropical Agriculturist, lxvii, pp. 69-79 (August 1926). Notes on the species of the genus attacking tea bushes, nature of injury, extent of damage, control etc. given. Recorded from Ceylon; Jepson, Tropical Agriculturist, lxxii, pp. 307-311 (1929). Recorded as attacking living plants in Ceylon. Deals with control; Dept. of Agriculture, Ceylon, Leaflet No. 24. Gives notes on termites attacking tea with their habits and control.

Sub-genus: *Neotermes*, Holmgren.

Calotermes (Neotermes) assmuthi, Holmgren, Jl. Bomb. Nat. Hist. Soc., xxii, No. 1, pp. 102-103 (April 1913). Species described. 'Termites in dry trunk of tree in garden. Tunnels built irregularly in wood and these, strange to say, altogether without inner lining of earthy material as is usually the case with termites.' Bangalore, India. Holmgren says that the said lining of tunnels is very often wanting with *Calotermes*, a species frequently found on living trees.

Calotermes (Neotermes) fletcheri, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 139 (August 1917). Recorded from Coimbatore, South India.

Calotermes (Neoteremes) militaris, Desneaux, Ann. Soc. Ent. Belgique, xlviii, p. 146 (1904). Species described; Green, Spolia Zeylanica, ix, pt. 33, p. 7 (June 1913). 'In stems of living tea throughout the tea districts of Central

Provinces; collected also in the Ratnapura District.' Recorded from Ceylon; Green, Tropical Agriculturist, xxviii, pp. 181-183 (March 1907). Here he gives an account of the nature of injury done to tea bushes, the extent of damage, the habits of the termite and control measures to be adopted; Holmgren, Spolia Zeylanica, viii, pt. 32, pp. 277-278 (January 1913). The imago described. Recorded from Peradeniya; Hutson, Tropical Agriculturist, lix, pp. 83-87 (February 1923). Notes on termites attacking tea, their habits and their control given. Recorded from Ceylon; Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 380-381 (1926). Species briefly described, from tea bushes, branches of tea and stems and roots of tea, recorded from Ceylon; Jepson, Tropical Agriculturist, lxvii, pp. 69-79 (August 1926). Deals with host plants in Ceylon, nature of injury to tea bushes and extent of damage and control; Jepson, Tropical Agriculturist, lxxii, pp. 307-311 (1929). Deals with the control of termites attacking living plants in Ceylon; Dept. of Agriculture, Ceylon, Leaflet No. 24. This deals with notes on termites attacking tea, their habits and control in Ceylon.

Calotermes militaris ab. unidentatus, Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 381-382 (1926). Species described, from branches, stems and roots of tea in Ceylon.

FAMILY: *MESOTERMITIDAE,* HOLMGREN.

SUB-FAMILY: LEUCOTERMITINAE, Holmgren.

Leucotermes, Silvestri.

Leucotermes ceylonicus, Holmgren, Escherich's Termitenleben auf Ceylon, p. 190 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 8 (June 1913). 'A troublesome domestic pest, destructive to wood work, packing cases etc., in outhouses: also in a dead Grevillea stump: from Peradeniya. Ceylon.'

Leucotermes indicola, Wasmann, Zool. Jahrb., p. 118 (1902). Recorded from Bombay, India; Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, No. 3, p. 776 (July 1912). 'From the Chemical Laboratory of St. Xavier's College room on ground floor; the termites seem to have come out from underground and had almost completely eaten up several boxes of dealwood of which they are specially fond; caught by lamplight in room.' Recorded from Bombay, Khandala; Holmgren, Jl. Bomb. Nat. Hist. Soc. xxii, No. 1, p. 103 (April 1913). 'In pillars of mound of *O. obesus,* in middle of nest, quite close to royal cell.' Recorded from Borivli near Bombay; Assmuth, Jl. Bomb. Nat. Hist. Soc., xxii, No. 2, pp. 372-384 (1913). Described as one of the wood-destroying white ants of the Bombay Presidency; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 140 (August 1917). Recorded from Punjab, Dhar (Gurdaspur District), India.

Arrhinotermes, Wasmann.

Arrhinotermes flavus, Bugnion, Mem. Soc. Zool. Fr., xxiii, p. 117 (1907); Green, Spolia Zeylanica, ix, pt. 33, p. 9 (June 1913). 'Discovered by Dr. Bugnion in stems of mangrove, Ambalangoda' in Ceylon.

Arrhinotermes heimi, Wasmann, Zool. Jahrb. Syst., xvii, p. 104 (1902). Species described and noted from Ceylon.

SUB-FAMILY: COPTOTERMITINAE, Holmgren.

Coptotermes, Silvestri.

Coptotermes ceylonicus, Holmgren, Escherich's Termitenleben auf Ceylon, p. 192 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 9 (June 1913). 'Commonly under decaying logs of wood; also about buildings, where it is destructive to deal packing cases; recorded as damaging books, in damp situations, the wood of tea chests and window frames in a tea factory; Peradeniya, Matala, Lindula, Nalanda, Trincomalee, Rattota, Ratnapura, Henaratgoda, Ambalangoda and Jaffna' in Ceylon; Holmgren, Termitenstudien, iv, p. 76 (1913); Kemner, Bull. Ent. Res., xvi, pt. 4, p. 384 (1926). Brief description given and recorded from Ceylon in dealwood, rafters of bungalow, and dead bark of *Hevea;* Jepson, Tropical Agriculturist, lxxii, pp. 308-309 (1929). Recorded as attacking living plants from Ceylon and deals with control.

Coptotermes gestroi, Wasmann, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 145 (August 1917). Recorded from Assam, India. 'In mound and wood in wall.'

Coptotermes heimi, Wasmann. Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, pp. 777-778 (July 1912). Other species of the genus compared and obtained by lamplight, on footpath and in room in wooden shelves partly eaten up. Noted from Bombay, India; Assmuth, Jl. Bomb. Nat. Hist. Soc., xxii, No. 2 (1913). Described as one of the wood-destroying white ants of the Bombay Presidency; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 144-145 (August 1917). Noted in various parts of India viz., Punjab, Bihar, Bengal, Madras, Coorg etc., with varying habits such as under galleries, on bark of Ficus, under log, running galleries into stem of mango tree, attacking wood of old cement-barrel filled with earth and used as a flower pot etc.; Silvestri, Rec. Ind. Mus., xxv, p. 225 (1923). 'Collected under the bark of dead tree trunk (*Ficus bengalensis*) lying on the ground. Widely distributed in South India.' Barkuda Island, Chilka Lake, India; Annandale, Rec. Ind. Mus., xxv, pp. 233-251 (1923). Nesting and swarming habits given.

Coptotermes parvulus, Holmgren, Jl. Bomb. Nat. Hist. Soc., xxii, No. 1, p. 104 (April 1913). Species described. Recorded from Guzerat, India, on trunks of trees and in dry firewood. Also recorded from Anand and Vadtal. Holmgren says that some *Coptotermes* dwell in live trees and thinks that this species is close to the Indo-Chinese *C. travians;* Assmuth, Jl. Bomb. Nat. Hist. Soc., xxii, No. 2, pp. 372-384 (1913). Described as one of the wood-destroying white ants of the Bombay Presidency; Silvestri, Rec. Ind. Mus., xxv, p. 225 (1923). 'Workers and soldiers.' Recorded from Barkuda Island, Chilka Lake, India; Annandale, Rec. Ind. Mus., xxv, pp. 233-235 (1923). Nesting and swarming habits given.

Coptotermes travians, Haviland, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 145 (August 1917). 'In galleries run over tarred beams in a house' and 'under galleries on bark of Ficus.' Recorded from Bengal, India; Bugnion, Mem. Soc. Zool. Fr., pp. 109-123 (1910). Recorded from Ceylon.

Termitogeton, Desneaux.

Termitogeton umbilicatus, Hagen, Zool. Bot. Ver. Wien, p. 472 (1858); Green, Spolia Zeylanica, ix, pt. 33, p. 9 (June 1913). 'A rare jungle species, Hantana (Kandy District), 3,000 ft.; Ramboda, 4,000 ft.,' Ceylon; Bugnion, Ann. Soc. Ent. Fr., lxxxiii, pp. 39-47 (1914). Description and notes given and also recorded from Ceylon.

Stylotermes, Holmgren.

Stylotermes fletcheri, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 142-144 (August 1917). 'Burrowing in rotten interior and in sound wood of a mango tree.' Recorded from Shevaroy Hills, about 4,000 ft., South India; Fletcher, Bull. Dept. Agr. India, No. 100, p. 246 (1921).

FAMILY: *METATERMITIDAE*, HOLMGREN.

Termes, Linnaeus.

Termes belli, Desneaux, Ann. Soc. Ent. Belgique, xlix, pp. 352-354 (1904). Species described. Mr. Bell gives a short account of the nest. Recorded from Karachi (Sind), India.

Termes brunneus, Hagen, Linn. Ent. xii, p. 133 (?) ; Green, Spolia Zeylanica, ix, pt. 33, p. 11 (June 1913). 'Soldiers said to be intermediate in size between *horni* and *Ceylonicus*. Precise locality uncertain.'

Termes estherae =(*convulsionarius*), Desneaux, Ann. Soc. Ent. Belgique, li, pp. 390-394 (1907). Recorded from Bippen, Bombay; Green, Spolia Zeylanica, ix, pt. 33, p. 33, p. 11 (June 1913). 'A very large species with soldiers of two or more sizes. Larger soldier with an enormous head and powerful jaws. Hambantota.' Ceylon. Mr. Bainbrigge Fletcher is of opinion that this name will have to give place to *convulsionarius* of Koenig-Schrift Ber. Naturf., iv, pt. 1, p. 24 (1779); Holmgren, Spolia Zeylanica, viii, pt. 32, p. 280 (January

1913). Recorded from Ceylon; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 145-146 (August 1917). Recorded from various parts of the Madras Presidency from nests in ground. Fletcher and Bugnion art of opinion that this species is identical with *Hodotermes convulsionarius;* but Holmgren thinks that proof for this is wanting.

Termes fatalis, Koenig, Schrift d. Berlin Naturf. iv, p. 1 (1779); Desneaux, Ann. Soc. Ent. Belgique, xlix, pp. 359-360 (1905). Synonymical notes given; Green, Spolia Zeylanica, ix, pt. 33, p. 11 (June 1913). 'Holmgren gives Ceylon as a locality for this species, probably on the authority of Hagen; but he doubts its generic position. It is said to be common mound-building termite of Tanjore, India; and its occurrence in Ceylon is doubtful.'

Termes mycophagus, Desneaux, Ann. Soc. Ent. Belgique, xlix, pp. 348-352 (1905). Species described and recorded from Karachi, Sind, India. Mr. Bell gives a short account about the nest and fungus combs.

Termes preliminaris, Holmgren, Escherich's Termitenleben auf Ceylon, p. 196 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 10 (June 1913). 'While describing this as a new species from winged adults caught' around a lamp at the Peradeniya resthouse Dr. Holmgren suggests that it may possibly be referable to some other species of which the adults are yet unknown.' Recorded from Ceylon.

Termes sindensis, Desneaux, Ann. Soc. Ent. Belgique, xlix, pp. 354-355 (1905). Species described and recorded from Karachi, Sind, India. Mr. Bell adds a note re-nest.

Termes taprobanes, Walker, Cat. Neur. Br. Mus., p. 522 (1853). (Syn. *T. peradeniya*, Holmgren, Escherich's Termitenleben auf Ceylon, p. 197); Green, Spolia Zeylanica, ix, pt. 33, p. 10 (June 1913). 'This species has hitherto been unrecognized by recent workers. Dr. Holmgren has identified specimens from Peradeniya, and Koslanda as referable to this species, but suggests that it is equivalent to *horni*. He also relegates his *peradeniya* (described from winged adults) to *taprobanes*.' Recorded from Ceylon.

Odontotermes, Holmgren.

Odontotermes anamallensis, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 157-158 (August 1917). Recorded from 'rotten log by roadside', 3,000 ft.; 'in rotten stump covered with sheets of mud.' Anamalai hills, north slope, about 4,000 ft.

Odontotermes assamensis, Holmgren, Stockholm Vet.-Ak. Handl., 50, No. 2, p. 114, pl. iv, f. 16 and v, f. 15 (1913?). Species new described from Assam, India.

Odontotermes assmuthi, Holmgren, Vet. Ak. Handl., 50, No. 2, p. 140 (1913?). Species described and noted from Bombay; Holmgren, Jl. Bomb. Nat. Hist. Soc., xxii, No. 1, pp. 112-113 (April 1913). Species described. 'Termites on trunk of tree, in tunnels and covered galleries built of friable greyish-black material.' Recorded from Borivli Jungle, India; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 154-155 (August 1917). Short description given. Noted among dead leaves under rotting branch, attacking a log of *Saissu* (*Dalbergia saissoo*) lying on the ground, and on wing at 9 a.m. after rain; Shevaroy Hills, Coorg, Bihar and Punjab in India.

Odontotermes bangalorensis, Holmgren, Stockholm Vet. Ak. Handl., 50, No. 2, p. 112, pl. iv, f. 15 (1913?). Species new, described from Bangalore; Holmgren, (Nec. *Bengalensis*) Jl. Bomb. Nat. Hist. Soc., xxii, No. 1, pp. 105-109 (April 1913). Described. A detailed account of the several nests from which the specimens were collected is given by Father Assmuth. Recorded from Bangalore, Krishnarajapuram, Hubli, India; Holmgren, Mem. Dept. Agr. India, Ent., Ser. v, No. 3, pp. 151-152 (August 1917). Noted in cattle dung eating a piece of rope, eating a bamboo 'chick', nibbling roots of cholam (*Andropogon*); galleries over bark of 'babul' tree (*Acacia arabica*) at light and on wing. Recorded from Coimbatore, Shevaroy hills, Bellary, Mysore and Punjab—India; Fletcher, Bull. Dept. Agr. India, No. 100, p. 246 (1921). Recorded from Hadagalli, South India nibbling roots of *cholam*.

Odontotermes bellahunisensis, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 150-151 (August 1917). 'Issuing from holes in gravelly soil at dusk', and 'from a hole in ground alongside road just before heavy rain; no mound at all, only one hole of exit.' Recorded from Madras and Mysore, *Odontotermes ceylonicus*, Wasmann, Zool. Jahrb., xvii, pt. 1, p. 113 (1902); Green, Spolia Zeylanica, ix, pt. 33, p. 9 (June 1913). 'Intermediate in size between *horni* and *redemenni*. Nests in the ground, without superstructure. Attacks roots of diseased or dying plants and trees. Peradeniya; Yatiyantota; Ratnapura; Balangoda.'—Ceylon; Bugnion, Deutsch Ent. National Bibliothek, ii, pp. 86-96; Bugnion, Rev. suisse de Zool. xix, pp. 383-395 (1911); Holmgren, Spolia Zeylanica, viii, pt. 32, pp. 280-281 (January 1913). Recorded from Peradeniya. '*O. ceylonicus* is readily distinguishable from other Ceylon species by the extensive yellow area surrounding the fontanelle.' The imago is described; Kemner, Bull. Ent. Res., xvi, pt. 4, p. 386 (1926). Briefly described and recorded from tea bush riddled by *Calotermes dilatatus*, in dead bark of *Hevea* (with one soldier of *Coptotermes ceylonicus*) and in dead tea wood.

Odontotermes distans, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 153 (August 1917). Species described. 'Winged imagines caught in a spider's web.' Recorded from Shevaroy Hills, Kadiar Rocks, about 4,000 ft.—India.

Odontotermes escherichi, Holmgren, Escherich's Termitenleben auf Ceylon, p. 195 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 10 (June 1913). 'A small species, occurring in dead tree stems and under decayed logs. Peradeniya.'—Ceylon; Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 386-387 (1926). Described from dead stems of *Grevillea* and in soil near dead tea bush, from Ceylon.

Odontotermes faeoides, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 156-157 (August 1917). 'Under log lying on ground amongst coffee.' Recorded from Coorg, India.

Odontotermes flavomaculatus, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 150 (August 1917). Described. 'On the wing'. Assam, India.

Odontotermes hornii, Wasmann, Zool. Jahrb., xvii, pt. 1, p. 111 (1902); Green, Spolia Zeylanica, ix, pt. 33, p. 9 (June 1913). 'A comparatively large species, common in decaying trees, and in soil treated with cattle manure; nests in the soil without conspicuous mounds; widely distributed; Ruenwella, Avisawlla, Ambalangoda, Hambantota,'—Ceylon; Holmgren, Spolia Zeylanica, viii, pt. 32, p. 280 (January 1913). Recorded from Peradeniya, Koslanda in Ceylon 'in branches of *Croton tigilum*'. According to Holmgren this is synonymous with *Termes peradeniyae* Holmgren and *Termes taprobanes?*; Oscar John, Spolia Zeylanica, ix, pt. 34, pp. 102-103 (October 1913). Notes on the habits of the species given; Bugnion, Rev. suisse Zool., xxi, pp. 299-330, pls. 3 (1913 ?). Recorded from Ceylon; Kemner, Bull. Ent. Res. xvi, pt. 4, p. 384 (1926). From nests in Ceylon.

Odontotermes horni var. *hutsoni*, Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 384-385 (1926). Fully described. 'In dead coconut log, living tea bush and in roots of cacao.'—Ceylon.

Odontotermes horni var. *minor*, Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 385-386 (1926). Fully described and recorded from dead wood of living tea and dead bark of *Hevea*.—Ceylon.

Odontotermes malabaricus, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 155 (August 1917). Under mud galleries on coconut stems; under log of *Grevillea* lying on the ground. Recorded from Malabar, Shevaroy Hills and Mysore in India.

Odontotermes mirganjensis, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 158 (August 1917). 'In rotten branch lying on the ground. Noted from Mirganj in Bengal, India.'

Odontotermes redemenni, Wasmann, Wien. Ent. Zeit., xii, pt. 7, p. 239 (1893); Green, Spolia Zeylanica, ix, pt. 33, p. 10 (June 1913). 'The commonest of the mound-building species in Ceylon. Widely distributed. Kandy, Colombo; Ambalangoda, Trincomalle, Hambantota, Jaffna and probably throughout the island of Ceylon'; Hutson, Tropical Agriculturist, lix, pp. 85-87 (February 1923). Deals with the habits and control of this scavenging termite from Ceylon; Hutson, Tropical Agriculturist, lix, pp. 294-298 (May 1923). Deals with habits, control etc.; Dept. Agr. Leaflet, No. 24.; Annandale, Jl. Bomb. Nat. Hist. Soc., xxx, pt. 1, pp. 25-34 (October 1924). Nest described; Kemner, Bull. Ent. Res. xvi, pt. 4, p. 386 (1926). 'In living tea bush' in Ceylon.

Odontotermes wallonensis, Wasmann, Holmgren, Jl. Bomb. Nat. Hist. Soc., xxii, no. 1, pp. 109-110 (April 1913). A detailed account of the nests examined is given by Assmuth. Recorded from Tuwa (Guzerat), Bangalore, Krishnarajapuram. According to Dr. Holmgren, Wasmann considers this species to be a subspecies of *O. obesus* with which the former does not agree but is inclined to group the species with *O. brunneus* which is confirmed by the structure of the nest of both the types; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 152-153 (August 1917). In mounds and under railway sleepers and under logs. Noted from Coimbatore, Bellary Dt., Mysore, Maddur, Bababudin Hills, Kollegal etc., from South India; Poona in Bombay Presidency and Hosangabad in Central Provinces.

Sub-genus: *Cyclotermes*, Holmgren.

Odontotermes (*Cyclotermes*) *brunneus*, Hagen, Linn. Ent. xii, p. 133 (?); Green, Spolia Zeylanica, ix, pt. 33, p. 11 (June 1913). 'Soldiers said to be intermediate in size between *horni* and *ceylonicus*. Precise locality uncertain'; Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, No. 3, pp. 783-784 (July 1912). For description vide Hagen's Monographie der Termiten, 1858. 'In dry cow dung completely perforated and traversed with tunnels . . .' from Khandala, India. Also from nest. A complete description of the nest is given by Assmuth. Also from different mounds and nests from different places. From Kirkee and from Poona. Species compared with others of the same genus. Also a note has been appended as regards its affinities with other species; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 153 (August 1917). From an earth mound from Poona in India.

Odontotermes (*Cyclotermes*) *obesus*, Ramb. Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, No. 3, pp. 778-783 (July 1912). In this paper Holmgren divides the species into a, b and c out of the specimens collected from numerous colonies and nests. Comparative measurements are given. All mostly taken from nests at different localities. Nests of these three types are discussed and a note at the end has been appended comparing them with the mound of *O. redemenni*. Localities: Khandala, Borivli Jungle (Salsette Island); Holmgren, Jl. Bomb. Nat. Hist., Soc., xxii, No. 1, pp. 104-105 (April 1913). 'Typical hillock nest. Royal cell in middle of mound slightly higher than the surrounding ground. 1 king and 1 queen. Nests abounding in guests . . .'; also on trunks of trees, in dry cow dung, logs of fire wood, nest under developed cactus shrub, in galleries of earth on *Pipal* tree etc.; Assmuth, Jl. Bomb. Nat. Hist. Soc., xxii, No. 2, pp. 372-384 (1913). Described as one of the wood-destroying white ants of the Bombay Presidency; Fletcher, Bull. Dept. Agr. India, No. 100, p. 246 (1921). Recorded from Quilandy, Malabar—damaging young cocconut palms, Coimbatore—galleries on tree trunks, Hadagalli—nibbling bark of small tree, Mysore city—on bark of *Grevillea*, Lyallpur,—on tree trunk, *Bankura*—eating sugarcane setts; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 146-149 (August 1917). Has very wide distribution throughout India of varying habits such as damaging young coconut palms, eating fallen leaves and sugarcane setts, under tree trunks, running galleries on tree trunks, in stumps of *Grevillea*, on Tasmanian railway sleepers etc.; Silvestri, Rec. Ind. Mus., xxv, pp. 223-224 (1923). Briefly described. 'Queen and king from a nest' from Barkuda, Chilka Lake, India; Annandale, Rec. Ind. Mus., xxv, pp. 233-235 (1923). Nesting and swarming habits given.

Odontotermes obesus f. gurdaspurensis, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 149-150 (August 1917). 'Swarming from hole in ground, at 9 a.m. after rain.' Gurdaspur, India.

Odontotermes obesus var. *oculatus*, Silvestri, Rec. Ind. Mus., xxv, pp. 224-225 (1923). Described from a nest. Barkuda, Chilka Lake, India; Annandale, Rec. Ind. Mus., xxv, pp. 233-251 (1923). Nesting and swarming habits given. Annandale, Jl. Bomb. Nat. Hist. Soc., xxx, pt. 1, pp. 25-34 (October 1924). The nest is described. India.

Odontotermes obesus var. *typicus*, Annandale, Jl. Bomb. Nat. Hist. Soc., xxx, pt. 1, pp. 25-34 (October 1924). The nest described—India.

Sub-genus: *Euscaiotermes*, Silvestri.

Odontotermes (*Euscaiotermes*) *primus*, Silvestri, Rec. Ind. Mus., xxv, pp. 221-222 (1923). A few workers and a soldier under stone. Species described. Barkuda Island, Chilka Lake—India.

Sub-genus: *Hypotermes*, Holmgren.

Odontotermes (*Hypotermes*) *marshalli*, Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 387-388 (1926). Described from a nest in ground, bamboo fence, and in dead stumps of *Grevillea*—Ceylon.

Odontotermes (*Hypotermes*) *obscuriceps*, Wasmann, Zool. Jahrb., xvii, pt. 1, p. 113 (1902); Green, Spolia Zeylanica, ix, pt. 33, p. 10 (June 1913). 'Another common mound-building species. The mounds indistinguishable from those of *redemenni*, but the insects easily recognizable by their dark brown heads. Apparently not so widely distributed as the previous species. Recorded from Peradeniya and Diyatalawa; Holmgren, Termitenstudien, iv, p. 141; Hutson, Tropical Agriculturist,' lix, pp. 85-87 (February 1923). Deals with habits and control of this scavenging termite. Ceylon; Hutson, Tropical Agriculturist, lix, pp. 294-298 (May 1923). Deals with habits and control; Dept. Agr. Ceylon, Leaflet No. 24.

Odontotermes (*Hypotermes*) *xenotermitis*, Wasmann, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 158-159 (August 1917). In mud galleries on tree trunks, under logs and in a pine post. Bengal, Dacca, Assam.

Sub-genus: *Odontotermes*, Holmgren.

Odontotermes (*Odontotermes*) *feae*, Wasmann, Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, No. 3, pp. 786-787 (July 1912). 'Eating up books and woollen goods after covering them with friable crusts of red soil. Room on underground floor; termites had come up from underground through crack in cemented pavement.' 'Also under stone, the surroundings of which clearly showed that this is one of the several kinds of white ants which, during nights, cover the surface of ground in neighbourhood of nest with friable galleries and more or less extensive coatings of red earthy material; the termites then eat what they have covered, leaving any portions outside the crust untouched.' These notes are by Father Assmuth. Recorded from Khandala, India; Holmgren, Jl. Bomb. Nat. Hist. Soc., xxii, No. 1, pp. 110-111 (April 1913). 'Mound described. Imagines swarming at sunset; also from a dry big leaf of fan-palm lying plastered over with tunnels of friable earthy material and eaten up, as far as covered by termites; also in half dry cow-dung completely hollowed out by them.' This note is by Father Assmuth. Recorded from Bombay and surroundings. Holmgren appends a note in which he says that this species of termites closes the nest-openings with a convex cover and is interesting because the South American *Eutermes* do the same when walling up the exits of their dwellings; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 156 (August 1917). 'In rotten logs, at light, running mud galleries up trunk of living trees, constructing mud galleries on grass, in dead *Grevillea*, in mud galleries of a mango tree, eating the bark of *Eucalyptus* etc.' Noted from Coimbatore, Coorg, Shevaroy Hills, Bangalore, Mysore, in South India; Dharwar and Belgaum in Bombay; Harra in Bengal; and Maymyo in Burma; Silvestri, Rec. Ind. Mus., xxv, p. 223 (1923). 'Winged specimens, swarming in middle night,' and a few soldiers and workers collected among roots of a dead tree; a few workers found in interior of a dead tree-trunk; species widely distributed in South India.' Barkuda, Chilka Lake, South India; Annandale, Rec. Ind. Mus., xxv, pp. 233-251 (1923). Nesting and swarming habits given.

Odontotermes (*Odontotermes*) *oblongatus*, Holmgren, Silvestri, Rec. Ind. Mus., xxv, p. 223 (1923). 'A few soldiers and workers collected in a dead tree-trunk,' Barkuda Island, Chilka Lake, South India.

Odontotermes (*Odontotermes*) *parvidens*, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 154 (August 1917). Described. Under logs, in wood and on bark of living *tagar* trees. In South India, Punjab, Bengal and Assam; Fletcher, Bull. Dept. Agr. India, No. 100, p. 245 (1921). 'On the Gauhati-Shillong road as a serious pest of *Cajanus indicus*, eating the roots.'

Microtermes, Wasmann.

Microtermes anandi, Holmgren ?, Stockholm Vet. Ak. Handl., 50, No. 2, p. 152 (1913?). Anand, India. Species described; Holmgren, Jl. Bomb. Nat. Hist. Soc., xxii, No. 1, p. 114 (April 1913). Species described. 'Termites together with *O. obesus* in some half-burnt boards of dealwood lying on ground in garden.' This is a note by Assmuth recorded from Anand (Guzerat); Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 160 (August 1917). Fletcher is of opinion that *anandi* should sink as a synonym of *O. obesi*. Found in logs of wood, under stone, under logs, in dead bamboo, attacking ripening wheat in fields, damaging growing cabbages, eating wood buried under ground, in tree stumps etc., recorded from Coimbatore, Shevaroy Hills, Bellary District, and Mysore in South India; Pusa in Bihar; Mirganj in Bengal; Silvestri, Rec. Ind. Mus., xxv, p. 225 (1923). 'Soldiers and workers in dead tree-trunk, numerous workers and few soldiers in galleries. Widely distributed in South India.' Barkuda Island, Chilka Lake, South India; Annandale, Rec. Ind. Mus., xxv, pp. 233-251 (1923). Nesting and swarming habits given.

Microtermes anandi forma curvignathus, Holmgren, Jl. Bomb. Nat. Hist. Soc., xxii, No. 1, p. 114 (April 1913). Species described from Bombay.

Microtermes globicola, Wasmann, Zool. Jahrb., xvii, pt. 1, p. 116 (1902); Green, Spolia Zeylanica, ix, pt. 33, p. 11 (June 1913). 'A very small species, constructing chambers and small spherical combs in the walls of mound-building termites. Precise locality undetermined.' Noted from Ceylon; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 159 (August 1917). Noted from under a flower pot in company with Staphylinid beetles, and under log of trimmed wood left lying on the ground, in Coimbatore and Mysore State.

Microtermes incertoides, Holmgren, Stockholm Vet. Ak. Handl., 50, No. 2, p. 151 (1913?). Species described and recorded from Wallon, India; Holmgren, Jl. Bomb. Nat. Hist. Soc., xxii, No. 1, pp. 113-114 (April 1913). From Wallon, found together with *O. wallonensis*. Holmgren says that Wasmann regarded this species as identical with *M. incertus*. Species described.

Microtermes? incertus, Hagen, Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, No. 3, pp. 788-789 (July 1912). Distribution discussed and compared with *M. obesi, M. sindensis, M. tragardh* etc. Noted from Khandala, from galleries constructed in a nest of *O. obesus* form *b* and under stone.

Microtermes macronotus, Holmgren, Termitenstudien, iii, p. 43 (1912); Green, Spolia Zeylanica, ix, pt. 33, p. 11 (June 1913). 'Recorded without description from Ceylon'; Holmgren, Stockholm Vet. Ak. Handl., 50, No. 2, p. 145, pl. vi, f. 1, p. 145 (1913?). Species new, described from Ceylon.

Microtermes mycophagus, Desneaux, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 159-160 (August 1917). 'Destroying furniture in bungalow' from Punjab, Lyallpur, India.

Microtermes obesi, Holmgren, Stockholm Vet. Ak. Handl., 50, No. 2, p. 150, pl. vi, f. 4 (1913?). Species new, described from Bombay; Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, No. 3, pp. 787-788 (July 1912). Species described and compared with *M. sindensis.* Noted from Khandala. Taken in nest of *Odontotermes obesus a*, Ramb.; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 159 (August 1917). At light from Mysore and Bihar; Fletcher, Bull. Dept. Agr. India, No. 100, p. 245 (1921). 'This termite is a serious pest of wheat seedlings at Pusa etc., and of wheat when coming into ear at Hosangabad. It also attacks cabbage and cauliflower at Pusa.'

Microcerotermes, Silvestri.

Microcerotermes annandalei, Silvestri, Rec. Ind. Mus., xxv, pp. 225-228 (1923). Fully described. 'A small number of specimens under bark of dead tree-trunk.' Barkuda, Chilka Lake, South India; Annandale, Rec. Ind. Mus., xxv, pp. 233-251 (1923). Nesting and swarming habits given.

Microcerotermes bugnioni, Holmgren, Escherich's Termitenleben auf Ceylon, p. 203 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 11 (June 1913). 'A minute species, found under logs of wood, in hollow stems of coconut palms etc., Ambalangoda; Maha Illuppallama (Anuradhapura District)'—Ceylon; Holmgren, Spolia Zeylanica, viii, pt. 32, pp. 283-284 (January 1913). Imago described. Noted from Ambalangoda; Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 390-391 (1926). Found in dead bark of coconut. Brief description given.

Microcerotermes cylindriceps, Wasmann, Zool. Jahrb., xvii, pt. 1, p. 121 (1902); Green, Spolia Zeylanica, ix, pt. 33, p. 12 (June 1913). Holmgren (in Escherich's Termitenleben auf Ceylon, pp. 203-204) records this species from Galle 'in decayed pines of stem'.

Microcerotermes fletcheri, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 170-171 (August 1917). 'Under dead log of sandalwood by pathside; red clayey soil; termites in galleries under mud along lower side of log. Very few soldiers.' From Mysore, Bababudin Hills, about 4,000 ft.

Microcerotermes greeni, Holmgren, Spolia Zeylanica, viii, pt. 32, p. 284 (1913); Green, Spolia Zeylanica, ix, pt. 33, p. 12 (June 1913). 'Distinguished by Dr. Holmgren, by the small size of the soldier'; Kemner, Bull. Ent. Res., xvi, pt. 4, p. 391 (1926). Very brief description given. In nest of dead tea. Ceylon.

Microcerotermes heimi, Wasmann. Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, No. 3, pp. 789-792 (July 1912). Father Assmuth gives an exhaustive note on the nest. All taken from nests. From Borivli Jungle (Salsette Island). Holmgren has appended a note in which he discusses about the different types of nests in the case of those of *Eutermes* and *Microcerotermes;* Assmuth, Jl. Bomb. Nat. Hist. Soc., xxii, No. 2 (1913). Described as one of the wood-destroying white ants of the Bombay Presidency; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 171 (August 1917). 'In galleries excavated in dead branches of a thorny bush. . .'. Mysore, Bababudin Hills about 4,200 ft., India.

Microcerotermes tenuignathus, Holmgren, Jl. Bomb. Nat. Hist. Soc., xxii, No. 1, pp. 116-117 (April 1913). Species described. 'In dry food.' Vadtal in Guzerat, India.

Mirotermes, Wasmann.

Mirotermes fletcheri, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 168-169 (August 1917). Species new described. From Bellary District. Humpi ruins about 1,200 ft. 'Found under stone'; also Bellary District, Hadagalli, 'in galleries in soil under a stone . . .'.

Sub-genus: *Mirotermes*, Wasmann.

Mirotermes (Mirotermes) obtusus, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 168 (August 1917). Bellary District, Hospet. 'Found in soil between surface and a depth of about one foot when digging up a nest of *Termes convulsionarius*.'

Hamitermes, Silvestri.

Sub-genus: *Synhamitermes*, Holmgren.

Hamitermes (Synhamitermes) ceylonicus, Holmgren, Stockholm. Vet. Ak. Handl., 50, No. 2, p. 225 (1913?). Species new described from Ceylon; Holmgren, Termitenstudien, iii, p. 91 (1912); Green, Spolia Zeylanica, ix, pt. 33, p. 13 (June 1913). This is at present a 'nomen nudum.' The name will probably replace *H. quadriceps* for the Ceylon species.

Hamitermes (Synhamitermes) quadriceps, Wasmann, Zool. Jahrb. xvii, pt. 1, p. 123 (1902); Green, Spolia Zeylanica, ix, pt. 33, p. 13 (June 1913). From 'under stones, Ambalangoda; Peradeniya' in Ceylon; Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, No. 3, p. 792 (July 1912). Holmgren creates a new subgenus *Synhamitermes*. From Khandala, India. Assmuth records the tunnels constructed in the pillars of a nest of *O. obesus* form *c*.

Sub-genus: *Euhamitermes*, Holmgren.

Hamitermes (Euhamitermes) indicus, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 165-166 (August 1917). Species new described. From Shevaroy Hills, South India, from 'under a stone amongst dead leaves . . .'

Eurytermes, Wasmann.

Eurytermes assmuthi, Wasmann, Zool. Jahrb., xvii, pt. 1, p. 124 (1902); Green, Spolia Zeylanica, ix, pt. 33, p. 12 (June 1913). 'Recorded from the collection of Dr. Escherich as "in association with *Termes obscuriceps;* and in earthen galleries under a stone, in the jungle." My own acquaintance with the species consists of the discovery of a small procession (containing winged adults and workers) travelling quite exposed—across a bare compound. They were emerging from one hole and entering another at a distance of about 5 yards'; Silvestri, Rec. Ind. Mus., xxv, p. 228 (1923). 'A number of nymphae, workers and a soldier collected from a bank of earth among roots of *Hemigyrosa canescens* and a few specimens from small chambers at the roots of a fig tree.' Barkuda Island, Chilka Lake, South India; Annandale, Rec. Ind. Mus., xxv, pp. 233-251 (1923). Nesting and swarming habits given.

Eurytermes assmuthi, Wasm. var. *modestior*, Silvestri, Rec. Ind. Mus., xxv, pp. 228-229 (1923). Described. 'A small nest with very young queen and king, a number of workers and a soldier.' Barkuda, Chilka Lake, South India; Annandale, Rec. Ind. Mus., xxv, pp. 233-251 (1923). Nesting and swarming habits given.

Eurytermes ceylonicus, Holmgren, Stockholm Vet. Ak Handl., 50, No. 2, p. 222 (1913?). From Ceylon; Holmgren, Termitenstudien, iii, p. 83 (1912); Green, Spolia Zeylanica, ix, pt. 33, p. 12 (June 1913). 'Noted as a species, but without description. Bainbrigge Fletcher (in litt) suggests that, as Holmgren records *assmuthi* from Bombay only, it is probable that he has separated the Sinhalese species as distinct.'

Capritermes, Wasmann.

Capritermes ceylonicus, Holmgren, Escherich's Termitenleben auf Ceylon, p. 204 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 13 (June 1913). 'Determined by Dr. Holmgren, from specimens collected by Dr. Escherich in nests of *Termes obscuriceps* at Peradeniya'—Ceylon.

Capritermes distinctus, Holmgren, Stockholm. Vet. Ak. Handl., 50, No. 2, p. 246 (1913?), pl. vi, f. 24, 30. Recorded from Ceylon.

Capritermes distortus, Silvestri, Rec. Ind. Mus., xxiv, pp. 541-543 (1922). Fully described. Noted from Kavalai (1,300-3,000 ft.), Cochin State.

Capritermes fletcheri, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 169 (August 1917). Species described. From Malabar, Puthupadi Forest 'under a rotting bamboo'; from Anamalai Hills about 4,000 ft. 'Colony in a dead log'; from Mysore, Bababudin Hills, 4,400 ft. 'In galleries and chambers two to ten inches below soil at roots of coffee.'

Capritermes gravelyi, Silvestri, Rec. Ind. Mus., xxiv, pp. 535-537 (1922). Koyna valley, Satara District, 2,000-2,100 ft., Kas, Satara District, 3,700 ft.—India.

Capritermes hutsoni, Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 391-392 (1926). In roots of tea, from Ceylon. Species described.

Capritermes incola, Wasmann, Wien. Ent. Zeit., xii, pt. 7, p. 242 (1893); Green, Spolia Zeylanica, ix, pt. 33, p. 13 (June 1913). 'In nests of *Termes obscuriceps*, Peradeniya,' Ceylon; Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, No. 3, pp. 792-793 (July 1912). 'Termites in pillars of nest of *O. obesus* form *a*.' Also under stone. Recorded from Khandala, India; Assmuth, Jl. Bomb. Nat. Hist. Soc., xxii, No. 2 (1913). Described as one of the wood-destroying white ants of the Bombay Presidency; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 170 (August 1917). From Nilgiri Hills, Ketti, 6,500 ft. in a potato field; from Coorg, Mercara, about 4,000 ft. in soil under sods and roots of grass; Mysore, Bababudin Hills, 4,600 ft. in galleries at roots of grass.

Capritermes longicornis, Wasmann, Zool. Jahrb., xvii, pt. 1, pp. 126-128 (1902); Green, Spolia Zeylanica, ix, pt. 33, p. 13 (June 1913). 'Dr. Holmgren doubts if this is specifically distinct from *incola*.'

Capritermes longirostris Wasm. var. *cornutella*, Silvestri, Rec. Ind. Mus., xxiv, pp. 537-538 (1922). Described from Randal Valley, Ratnagiri District.

Capritermes obtusus, Silvestri, Rec. Ind. Mus., xxv, pp. 229-231 (1923). Fully described. 'Few specimens under stone on damp soil at base of small fig tree.' Barkuda Island, Chilka Lake, South India; Annandale, Rec. Ind. Mus., xxv, pp. 233-251 (1923). Nesting and swarming habits given.

Capritermes obtusus Silv. var. *abbreviatus*, Silvestri, Rec. Ind. Mus., xxv, pp. 231-232 (1923). Barkuda Island, Chilka Lake, South India.

Capritermes punjabensis, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 170 (August 1917). From Lyallpur, Punjab.

Capritermes speciosus, Haviland, Jl. Linn. Soc. London, xxvi, p. 413 (1898); Green, Spolia Zeylanica, ix, pt. 33, p. 13 (June 1913). 'Doubtfully from Trincomalle'.

Capritermes tetraphilous, Silvestri, Rec. Ind. Mus., xxiv, pp. 543-544 (1922). Fully described. From Rangamati, Chittagong, Bengal.

Eutermes, Heer.

Eutermes biformis, Wasmann, Zool. Jahrb., xvii, pt. 1, p. 133 (1902); Green, Spolia Zeylanica, ix, pt. 33, p. 14 (June 1913). 'Possibly a variety of *rubidus*, Galle; Ambalangoda: both *rubidus* and *biformis* have soldiers of two sizes'; Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, No. 3, p. 793 (July 1912). Borivli Jungle, Salsette Island: in small galleries built on surface of bare ground; Khandala: most of these taken from under stone; Assmuth, Jl. Bomb. Nat. Hist. Soc., xxii, No. 2 (1913). Described as one of the wood-destroying white ants of the Bombay Presidency; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 162-163 (August 1917). Shevaroy Hills about 4,500 ft.—'Nest under stone, interior of galleries blackened; also Madras and Saidapet'; Hingston, Jl. Bomb. Nat. Hist. Soc., xxxii, pt. 4, pp. 717-725 (31st May 1928). The author gives a very interesting account of the insect from Central India; he also gives an account of the nest, foraging expeditions, duties of soldiers, special senses, and the insects compared with Hymenoptera.

Eutermes ceylonicus, Holmgren, Escherich's Termitenleben auf Ceylon, p. 179 (1911). (?=*inania* var. *horni*, Wasmann); Green, Soplia Zeylanica, ix, pt. 33, p. 14 (June 1913). 'Nests in decayed wood. Constructs galleries of earthy or ligneous material, extending up the trunks of trees. A widely distributed species. Peradeniya, Kudugannawa, Ratnapura, Trincomalee, Passara, Diyatalawa'—Ceylon; Bugnion, Ann. Soc. Ent. Fr., lxxxiii, p. 361 (1914). Deals about the buccal pieces. Ceylon; Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 388-389 (1926). Short description given. From galleries and bark of tea bush; reported ring-barking tea stem; dead wood of tea; and dead portion of dadap stem.

Eutermes ceyloniellus, Kemner, Bull. Ent. Res., xvi, pt. 4, p. 389 (1926). Ceylon: in stem and roots of tea.

Eutermes crassicornis, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 162 (August 1917). Anamalai Hills, 4,000 ft. in 'galleries in ironwood'; Coorg, Sidapur, Margalli Estate, 3,500 ft. 'In gallery leading up tree trunk. The nest could be seen about 20 ft. up there'; Mysore, Bababudin Hills about 4,700 ft. 'in galleries over rotten logs and in these logs'.

Eutermes escherichi, Holmgren, Escherich's Termitenleben auf Ceylon, p. 199 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 15 (June 1913). 'Collected by Escherich in a nest of *Termes obscuriceps*, Peradeniya'—Ceylon; Oscar John, Spolia Zeylanica, ix, pt. 34, pp. 107-109 (October 1913). Notes on the species given.

Eutermes fletcheri, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 161-162 (August 1917). Species described. Shevaroy Hills, 4,000 ft. 'Running black galleries over a rock in the cracks of which were found large numbers of soldiers, workers, nymphs and young.' Also in 'galleries over dead tree-stump and in chambers excavated in mud and bark of same.'

Eutermes hantanae, Holmgren, Escherich's Termitenleben auf Ceylon, p. 198 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 14 (June 1913). 'A rare species; recorded from Hantana range only'—Ceylon; Bugnion, Spolia Zeylanica, ix, pt. 35, pp. 155-162 (March 1914). Described and compared with other species of the genus; Bugnion, Ann. Soc. Ent. Fr., lxxxiii, p. 362 (1914). Deals about the buccal pieces.

Eutermes heimi, Wasmann, Zool. Jahrb., xvii, p. 135 (1902). From India; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 163 (August 1917). Coimbatore—'abundant here coming out towards sunset and foraging little bits of dead grass etc., and sometimes biting off pieces of green grass and carrying them into the nest. The individuals have a very characteristic aromatic odour'; Madras—'At light'; Bellary District—'Under a stone in Humpi ruins'; Mysore State, Maddur—'in the ground at roots of a tree alongside a colony of *Camponotus*'.

Eutermes inanis, Haviland, Jl. Linn. Soc. London, xxvi, p. 425 (1898); Green, Spolia Zeylanica, ix, pt. 33, p. 14 (1913). 'Recorded by Dr. Bugnion from Ambalangoda'—Ceylon.

Eutermes indicola, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 161 (August 1917). From Coorg and Anamalai Hills. 'From nests in live trees and in dead stump.' Species described.

Eutermes kotuae, Bugnion, Ann. Soc. Ent. Fr., lxxxiii, pp. 351-359 (1914).

Deals about the buccal pieces, Ceylon; Bugnion, Ann. Soc. entom. suisse., xii, pp. 192-200 (1914)—Ceylon.

Eutermes lacustris, Bugnion, Compt. Rend. Sci. Soc. Biol. (Fr.), lxxii, p. 1091 (1912); Green, Spolia Zeylanica, ix, pt 33, p. 15 (June 1913). 'In stems of "Kaju-nut" (*Anacardium*), *Hevea, Elaeocarpus*. Ambalangoda, Kalutara. Distinguished from all the other local species of *Eutermes* by the dark brown heads of the soldiers'; Bugnion, Rev. suisse de Zool., xx, pp. 487-505 (1912)—Ceylon; Holmgren, Spolia Zeylanica, viii, pt. 32, pp. 282-283 (January 1913). Green has added a footnote wherein he states that Dr. Holmgren originally described this species as a new species *E. greeni*, but Dr. Bugnion has already published this as *E. lacustris* thereby taking precedence. Soldier and worker described; Oscar John, Spolia Zeylanica, ix, pt. 34, pp. 110-112 (October 1913). (=*E. greeni*, Holmgren, 1912.) Notes on the species given; Bugnion, Spolia Zeylanica, ix, pt. 35, pp. 149-154 (March 1914). The imago described.

Eutermes longicornis, Holmgren, Stockholm Vet. Ak. Handl., 50, No. 2, p. 172, pl. vii, f. 5 (1913?). Species new from Ceylon; Holmgren, Spolia Zeylanica, viii, pt. 32, p. 283 (1913); Green, Spolia Zeylanica, ix, pt. 33, p. 15 (June 1913). 'On stems of "Giant Bamboo" (*Dendrocalamus giganteus*) and also in a nest of *Termes obscuriceps* Peradeniya'—Ceylon; Bugnion, Ann. Soc. Ent. Fr., lxxxiii, pp. 361-362 (1914). On the buccal pieces—Ceylon.

Eutermes monoceros, Koenig, Schrift Berl. Nat., iv, 17, p. 25 (1779); Green, Spolia Zeylanica, ix, pt. 33, p. 14 (June 1913). 'The common black termite of Ceylon. It constructs its nests in hollow stems and branches of trees, guarding the entrances by pendent masses of black material composed of the excreta of the insects. Long processions of the termites, sometimes extending several hundred yards, may often be seen crossing the roads. Found throughout the island, upto about 2,000 ft.'—Ceylon; Bugnion, Ann. Soc. Ent. Fr., pp. 271-281 (1909); Bugnion, Bull. Soc., v and Sc. Nat., xlvii, pp. 417-437 (1911); Bugnion, Bull. Soc. ent. suisse, xii, f. 4, pp. 119-123 (1912); Oscar John, Spolia Zeylanica, ix, pt. 34, pp. 112-116 (October 1913). Notes on the habits of the species given; Petch, Ann. Royal Bot. Gardens (November 1913); Bugnion, Ann. Soc. Ent. Fr., lxxxiii, pp. 359-360 (1914). Gives an account of the buccal pieces—Ceylon.

Eutermes oculatus, Holmgren, Escherich's Termitenleben auf Ceylon, p. 200 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 15 (June 1913). 'Described from winged adults only, Peradeniya. Probably the winged stage of *E. escherichi*'; Oscar John, Spolia Zeylanica, ix, pt. 34, p. 109 (October 1913). (=*Eutermes longicornis*, Holmgren, 1912). Notes on the species.

Eutermes preparvus, Holmgren, Escherich's Termitenleben auf Ceylon, p. 201 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 15 (June 1913). 'Also described from winged adults only, collected by Dr. Uzel at Peradeniya and Henaratgoda'—Ceylon.

Sub-genus: *Grallatotermes*, Holmgren.

Eutermes (*Grallatotermes*) *grallatoriformis*, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 163-164 (August 1917). Anamalai Hills, Tellkadi, 'under long galleries on mango stem'; in South Kanara, Aryapur. Holmgren is of opinion that the species is noteworthy in that it reminds one strongly of *Eutermes grallator*, from New Guinea.

Sub-genus: *Subulitermes*, Holmgren.

Eutermes (*Subulitermes*) *inaniformis*, Holmgren, Stockholm Vet. Ak. Handl., 50, No. 2, p. 154, pl. vii, f. 1 (1913?). Species new. Hinterindien.

Sub-genus: *Trinervitermes*, Holmgren.

Eutermes (*Trinervitermes*) *rubidus*, Hagen, Linn. Ent., xiv, p. 117 (1860); Green, Spolia Zeylanica, ix, pt. 33, p. 14 (June 1913). 'A widely distributed species. Found under stones, and forming small piles of fine earth on the surface of the soil. Peradeniya, Anuradhapura, Ambalangoda, Diyatalawa'; Holmgren, Escherich's Termitenleben auf Ceylon, pp. 133-134 (1910). Observations on the species; Oscar John, Spolia Zeylanica, ix, pt. 34, pp. 104-107 (October 1913). Noes on the species; Bugnion, Ann. Soc. Ent. Fr., lxxxiii, p. 362

(1914). Deals with the buccal pieces, Ceylon; Kemner, Bull. Ent. Res., xvi, pp. 389-390 (1926). Description brief. Grass lawn. Ceylon.

Anoplotermes, Fr. Muller.

Sub-genus: *Speculitermes,* Wasmann.

Anoplotermes (Speculitermes) cyclops, Wasmann, Zool. Jahrb. xvii, pt. 1, p. 161 (1902); Green, Spolia Zeylanica, ix, pt. 33, p. 13 (June 1913). 'Under logs of wood, Peradeniya, Maha Illuppallama,' Ceylon. *Anoplotermes* is distinguished by the absence of the soldier caste. The workers might readily be mistaken for those of *Eutermes,* of which Dr. Holmgren considers this genus to be an offshoot; Oscar John, Spolia Zeylanica, ix, pt. 34, pp. 103-104 (October 1913). Notes on the species given; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 164-165 (August 1917). Shevaroy Hills, 'under stone'; Bellary District, 'from galleries in earth' and 'under dead *agave* stumps lying on the ground'; Coorg, 'in soil, said to damage coffee roots, but this is doubtful'; Mysore, Bababudin Hills, 'in galleries and chambers in the ground . . .'

Termopsis, Heer.

Termopsis wroughtoni, Desneaux, Jl. Bomb. Nat. Hist. Soc., xv, pt. 3, pp. 445-446 (1904). Kashmir, species new, described; Desneaux, Jl. Bomb. Nat. Hist. Soc., xvii, pp. 293-298 (1906). (=*Termopsis Radcliffe*: Indian Forester, p. 412. Gives an account of the genus.) In old stumps of *Pinus excelsa.*

Eremotermes, Silvestri.

Eremotermes fletcheri, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 167-168 (August 1917). Species described. Coimbatore, 'issuing from holes in ground at 0-30 p.m. during sunshine'.

Eremotermes paradoxalis, Holmgren (=*Pseudomirotermes,* Holmgren) Stockholm Vet. Ak. Handl., 50, No. 2, p. 232 (1913?). Vorderindien. Species new; Jl. Bomb. Nat. Hist. Soc., xxii, No. 1, pp. 115-116 (April 1913). Bangalore, 'in remarkably flat tunnels (transverse section oblong-ovate) constructed in pillars of mound of *O. bangalorensis.*' Holmgren thinks that it will be interesting to know whether this genus—like *Mirotermes*—contains forms jumping by the aid of their mandibles; in this case the parallelism with *Mirotermes* would be nearly complete. Species new; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 166-167 (August 1917). Coimbatore, 'emerging from small holes in the ground after a shower of rain, at about 4 p.m. . . .'; Central Provinces, 'on outskirts of mound-nest . . .'; Bihar, 'on wing, 5-30 to 6-30 p.m. over grass lawn'.

REVIEWS.

THE NIDIFICATION OF THE BIRDS OF THE INDIAN EMPIRE. By E. C. Stuart Baker, C.I.E., O.B.E., F.Z.S., etc. Volume III. PLOCEIDAE-ASIONIDAE. (Taylor and Francis, 30/-.)

The present volume completes the account of the nidification of the Passeres, the families dealt with being the Weavers, Finches and Buntings, Swallows and Martins, Wagtails and Pipits, Larks, White-Eyes, Ruby Cheek, Sunbirds, Flowerpeckers, Pittas and Broadbills.

It continues with the Non-Passerine or Pico-Passerine birds, including the Woodpeckers and Wryneck, Barbets, Cuckoos, Parrots, Rollers, Bee-eaters, Kingfishers, Hornbills, Hoopoes, Trogons, Swifts, Nightjars, and concludes with the Owls.

In a review of Mr. Stuart Baker's second volume of this work which appeared in a contemporary, exception was taken to the classification, which the writer held to be inaccurate, and it therefore seems to us essential that we should also refer to this point.

The volumes on Nidification are written on the same lines as the Bird volumes of the Fauna of British India by the same author, and it stands to reason that the same classification is adopted in both works.

So far from being inaccurate, this work is, in the words of an American review, 'the last word in patient and exhaustive research, bringing nomenclature up to date, and laying a wonderful foundation for further detailed research'. The author has, moreover, himself carried the nomenclature in the present work to a still further degree of accuracy, and has included all the corrections rendered necessary by his own discoveries and by those of other ornithologists since the dates on which the Fauna appeared.

Yet another point to which we would allude is the alteration in so many of the trivial names, which have been made in the interests of future, and not of past, ornithologists and students. As the author himself remarks, to call a bird by a man's name, e.g. 'Baker's Sparrow' or 'Jones' Titmouse' conveys nothing to the mind of the student, whereas such names as 'The Punjab House Sparrow' or 'The Ceylon Black-headed Titmouse' to give a couple of imaginary names, would at once convey an idea both of description and locality.

Field naturalists have long deplored the use of these meaningless complimentary names in trivial nomenclature, and we congratulate the author on his break with tradition in the interests of common sense.

These being our views on the above points, it is almost needless to add that in the present work Mr. Stuart Baker fully maintains the high standard which he set himself in the previous volumes. We have learnt to anticipate this from past experience of his writings and expectations are more than realised. In fact, we will go so far as to say that this book surpasses in interest even the two preceding, dealing as it does with some of the most extraordinary and varied nesting habits ,that it is possible to conceive.

As in the earlier volumes, the serial number given corresponds with that in the Avifauna, and of the total of 704 species and subspecies included in that work, the nidification of 545 species and subspecies is now recorded. Of the remainder, 61 breed outside the area of the present work, whilst nothing is so far known of the breeding habits of the remaining 92.

It is possible that some disappointment will be felt that limitations of space have precluded the author from telling us more about the parasitic Cuckoos, a subject upon which he is undoubtedly the greatest living authority.

Consolation however is forthcoming in his promise to devote a separate work exclusively to this fascinating subject, and in this book all that is known will be exhaustively dealt with and the various theories, with the evidence for and against them, fully discussed. This work, when it appears, should be of the most absorbing interest, and will be eagerly awaited.

Returning to the book under review, the description of the nests and lovely eggs of the Rose Finches makes most fascinating reading, and there are very full accounts of that curious species the Forest Wagtail, of the exquisite nests of the Spider Hunters, of the Sunbirds, and of the tiny Flowerpeckers.

Of different, but equal interest are what may, for want of a better term, be called the curiosities of bird architecture. Among these we would draw attention to the (apparently unnecessarily) huge structures of some of the Broadbills, and going to the other extreme, the tiny felted pads of the Frogmouths, birds of considerable size; and to the penchant of certain Woodpeckers and Kingfishers for ants' nests in which to lay their eggs, and to the immunity of these from destruction by the ants.

To these may be added the well known immuring of female Hornbills during incubation and often for some time after the eggs are hatched; the nesting habits of the Spinetails, which for so long defied all the efforts of field workers; the Swiftlets, famed as the producers of edible nests, and the well nigh invisible saucer of the Crested Swifts, barely large enough to contain the single egg.

It is safe to say that from the first page to the last the book is a mine of information, much of which is new, and all of which is set out in the eminently readable style, coupled with scrupulous accuracy, which one has come to associate with everything that emanates from Mr. Stuart Baker's pen.

We have only been able to detect one error, and this doubtless occurred in copying the manuscript note accompanying the eggs. We refer to the description of the nesting of the Javan Small House Swallow on the cliffs in Arakan, where the nests were only 18 *inches* and not 18 *feet* from the top. This accounts, of course, for the remark that the nests were easily accessible from above, as the finder informs us that he had merely to walk along the top from the land side to reach the nests, though these would have been quite inaccessible from the sea below.

The book contains eight beautiful photographs, the work of Col. Rattray and Capt. Bates, with a frontispiece by the author, and once again the printing leaves nothing to be desired.

Volume iv, which will be the last, is nearing completion, and will include the Accipitrine birds, Game birds and Waterfowl.

C. H.

HUNTERS' MOON. By Major LEONARD M. H. HANDLEY, M.C., pp. 267, price 15/. (Macmillan & Co., Ltd., London.)

There surely should be some limit to the inaccuracies which find their way into modern books which purport to set forth observations of interest to Natural Scientists and Shikaris.

A recent book *Hunters' Moon*, by Leonard Handley, is so open to criticism in this respect that one is led to the conclusion that the author has depended on his imagination and trusted to the credulity of the public, for purposes of producing a 'best seller' rather than a work of sporting or scientific value.

The following observations in this book are I consider inaccurate:—

(1) The author's trackers having tied a full grown sambhur stag to a jungle branch shouldered and carried it off. To anyone knowing the size and weight of a full grown sambhur stag this feat would seem to be an impossible one.

(2) A part of the C. P. jungles is described as being unknown and unowned. This information should be of interest to the Government of India and to the Forest Department of the C. P.

(3) The author describes the Sladang as *Malay buffalo*!

(4) The author sees 'two luminous eyes' of what he takes to be a snake watching him from the 'depths of a tree trunk' at night.

(5) An elephant, mortally wounded in its spine, managed to cross a river and dies in the effort!

(6) The author speaks of trying to eat the 'perfectly formed foetus' of an Octopus, although an Octopus is oviparous. If the author did eat one at all it must have either been a very young specimen or an embryo from an egg.

(7) The author apparently had a good moon for the whole period of two months he was in the Tenasserim jungles.

(8) He is not accurate in his dates. He starts off after a man-eater in February and on the 9th January he arrives at his destination!

(9) In his descriptions of the man-eater's victims the left leg in each case is said to have been devoured. The photo of one of the victims shows the left leg intact!

(10) The author arrives in the evening at a Gond village. Later he and four of the villagers ('tired out with the gathering of the day's crop') sleep round a fire. The man-eater seizes one of the villagers and a photo is shown of the victim holding the author's rifle and described as his 'favourite Gond', regardless of the fact that the author had not met him before, and no photograph could have been taken when the author and his two Gonds from another village arrived late and tired.

(11) The author writes that no animal could recover almost instantaneously from a solid .470 bore bullet and get clean away: quite a mistaken idea. Elephants and the larger game animals frequently do so, if hit in a non-vital spot, just as a bison shot by the author with his .470 bore rifle nearly gets away.

(12) The old fallacy about the necessity of allowing a leech to drink to satiation, otherwise if pulled off 'a portion of the epidermis is removed' is repeated by the author.

(13) The author should make it clear that his Tanoy (the Siamese poacher) has no connection with the well-known Tracker (and poacher) of the same name of those parts—who is still alive and active.

(14) Besides moths, flying ants, tree spiders, mosquitoes and horned beetles are apparently included in the '*flying lepidoptera* of the Ceylon jungles'.

(15) It is not understood why the hills of Ranga are persistently termed 'Blue Hills' when it is admitted that their Canarese name indicates 'white hills'. The Nilgiris, an adjoining range, are the Blue Hills.

(16) Blue Gums are incorrectly described as growing in Mysore City.

(17) The western boundary of a shooting Block is described as being 'lost in Mysorean infinity'. In actual fact another shooting Block intervenes between this and the Mysore territory.

(18) The big game on the Billigirirangans in South India is described as migrating to the small jungle clad sholas during the monsoon to avoid the 'torture of leeches'. Actually during the monsoon most of the big game animals leave the sholas (evergreen jungle) which are then infested with swarms of leeches.

(19) Quite incorrectly 'Mulay Kadu' is described as meaning 'great rain forest'. It is nothing of the kind. Mullay Kadu means 'hill forest' (*Canarese*: Malay—hills; kadu—forest) and the deciduous jungle alone is termed thus by the local Sholagas. The author errs in this with better company, as the late G. P. Sanderson in his *Thirteen Years among the Wild Beasts of India* makes the same mistake, and this error is presumably copied by the author as he quotes from Sanderson's book on another page.

(20) The bite of green Grass Adders is described as being fatal. This is hardly correct, as only small children, or a person in a very weak state of health, would be likely to die from the effects of the bite of one of these snakes, nor is it understood how the author came across so many of these species during the S.-W. monsoon.

(21) A honey bird is described as leading the author and his trackers to its hive, an old and incorrect fairy tale. A honey bird is so called I believe on account of its habit of feeding on the nectar in the flowers.

(22) A saddle is incorrectly described as meaning 'Elephant crossing': actually the name means 'Mara's (man's name) Saddle'.

(23) 'F' of Bedaguli is described as having been killed in the war and buried 'betwixt the Tigris and the Euphrates'. Actually 'F' died from pernicious anaemia and was buried in Kent some years after the war.

(24) The author's sadness is described at seeing relics of 'F's' huts etc. in the jungle. 'F' was still alive at the time of the author's tale and moreover used those very huts later.

(25) All sportsmen will condemn the author's advice that a snapshot should be taken at a bull bison if no clear shot is obtainable. Many a wounded bull has been lost, and a cow shot in mistake for a bull, by shikaris adopting these tactics, and this type of advice cannot be too strongly deprecated.

(26) The author speaks of the great forest of 'Sal' on the Billigirirangans. There is no sal growing on the Billigirirangans, nor, I think I am correct in saying, anywhere in South India.

(27) 'Shaking with excitement I throw all precautions to the wind and aim into the brown of the great shadow ahead'! The unfortunate 'great shadow ahead' is a bison which the author very luckily managed to bag.

(28) The bison is described as making for 'the wall of the great Mulay Kadu', and it is indicated that the bison would have been lost had it reached its objective. The Mulay Kadu is the natural habitat of bison, open deciduous jungle where most bison are tracked and shot.

(29) Jackals are described as being near the author's camp on the Billigirirangans. There are however no jackals on these hills.

(30) Dodsampagai block is described as stretching west from a certain spot. Actually this shooting Block lies north from the locality indicated, Coimbatore lying to the South.

(31) A rough palisade of jungle bamboo, described as having been placed by the author round his camp to give warning of the approach of elephants and shown in the photo of his hut on page 260 was not erected by the author but by a Planter on the Billigirirangans. The fence was erected to keep out cattle. The photo is of the Planter's camp which he was permitted the use of.

(32) The story of the elephant cow 'galloping off', on the author's approach, after giving birth to a still born calf sounds incredible. A cow elephant with a newly born calf (alive or dead) is an exceedingly dangerous and aggressive animal.

(33) It is not explained how the author's Sholaga tracker blew off the Russel Viper's head with the rifle the author was carrying. If it is meant that the tracker accomplished this with a second gun, the author must have been as near to death from the tracker's feat as from the Viper, unused as are Sholagas to modern weapons.

(34) The tale of the Hyaena and the wild dog pack sharing the same meal is incredible. I doubt if any authentic case has been known of wild dogs tolerating the close proximity of another animal while feeding?

(35) The District Forest Office unfortunately shows no record of 12 wild dogs and a tiger having been shot by the author at the time described. A tiger, and about this number of wild dogs, *were* however shot by another sportsman in the same Block that year.

(36) The story on page 253 of the author climbing down from his machan, leaving his rifle (surely a very foolish act), to investigate a noise is remarkable. He describes a bamboo jungle as being inky black (although there was a 'full moon in a cloudless sky') and yet he manages to see a black sloth bear. Returning the author sees 'in the distance' a great carnivorous beast approaching along a fire line which he had to cross. It is not explained how the animal did not see him, but it passed so close that 'he could have touched every spot on his sleek body'.

(37) The reference to a bamboo receptacle as a requirement on a machan for certain purposes is crude and vulgar. Most normal sportsmen find no necessity for this.

(38) The stories of the elephant removing the author's machan ladder, the tin of Army Rations bursting in his tracker's face, and the visit of an elephant to his Hulpatchayhulla camp (which the author was invited to) are a remarkable series of coincidences as these were also the experiences of a Planter on the Billigirirangans and were related to the author.

There is no record in the Office of the Deputy Commissioner, Mandla, nor in the Mandla Division (including the Danauli Reserve) Forest Office, of the author having destroyed the Danauli man-eater, which is said to have been killed later by a Mrs. Haygate. The author shot in the Bajag Block in February 1925, to my knowledge, and the man-eater was destroyed in 1926 in the same area.

In conclusion I consider the author's 'Apologia' at the end of his book as inadequate and misleading.

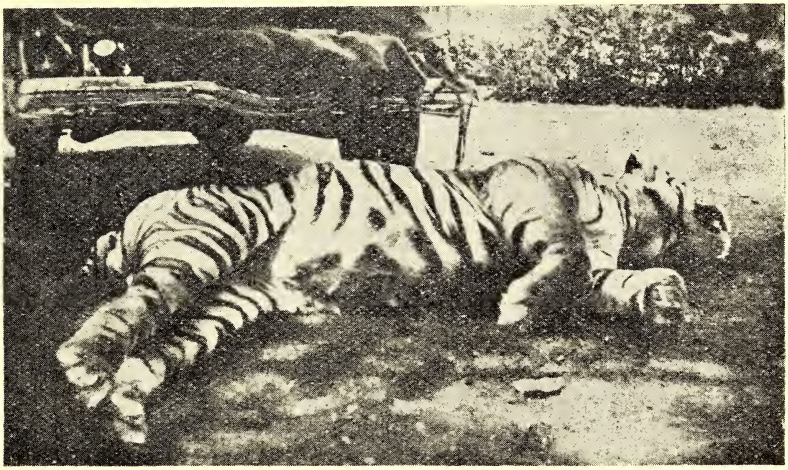
R. C. M.

MISCELLANEOUS NOTES.

I.—A TAILLESS TIGER.

(*With a photo*).

Early in the morning of the 1st instant I shot a very large tailless tiger. On examination I was interested to find that there was merely a blob of flesh ending up with loose skin, much the same as goats have, and that there was no sign of gristle or hard root that would indicate that the tiger had had a normal tail previously.



The tiger measured 6¾ ft. between pegs and would have measured quite 10 ft. had it possessed a normal tail judging from the length of the tail of a 10 ft. tiger I shot in 1931.

I enclose a photo of the tiger and a close-up of its 'goaty' tail.

Honnametti Estate,
Attikan P.O., *Via* Mysore,
S. India.
May 26, 1934.

R. C. MORRIS, F.Z.S.

II.—'RATELS AND CORPSES'.

Mr. Champion in his book *The Jungle in Sunlight and Shadow* writes thus: 'This accusation of *eating* corpses is a libel which is widely brought against this animal by people who do not know what a Ratel is. So far as I am aware no reputable naturalist has ever obtained first-hand evidence of such an act on the part of these creatures which are so omnivorous that they can have little difficulty in obtaining ample food of other kinds. True it is Dunbar Brander states in his book that he once gave evidence in a murder case of *this* habit of the Ratel; but if I had been the Judge, I am afraid that I should have questioned his evidence very closely indeed, for *it was almost certainly based on Indian superstition*, which by no means always follows facts.'

What I wrote in *Wild Animals in Central India* was as follows:

'They also eat carrion and one of their names "The Grave-Digger" is thoroughly earned as I have known them *exhume* a corpse. I once had to give evidence regarding this habit in a murder trial, the defence relying on the exposed human remains being those of a corpse removed from an adjoining grave.'

In view of the fact that Mr. Champion has freely quoted from *Wild Animals in Central India* as well as obviously finding its textual content very useful, it is lamentable that he should not have referred to me before publishing the rash and incorrect statement to which he has committed himself.

Had the name 'Grave Digger' rested merely on Indian superstition, this would have been stated. From the context of what I wrote, it is obvious, that it rested on no such insecure foundation. 'Other Jungle Animals' are treated in the concluding chapter of *Wild Animals in Central India*, and this chapter commences by definitely stating, that the difficulty arose as to what to say, and what to omit. As a matter of fact to have said all, would have entailed at least another, and companionate volume, to the one published.

It is now necessary to satisfy Mr. Champion's unfulfilled desires to cross-examine me. Before doing so, however, it is pertinent to enter an objection to the self-appointed 'Judge'—as he confuses 'eating' *his* word, in *his* book, with the word 'exhume'—*my* word, in *my* book. It is a point worth mentioning, although not one to which I attach great importance, as I certainly will not acquit the Ratel of possibly eating from a corpse. The point is on the judge not the Ratel. Mr. Champion in his book refers to the Ratel having been known to eat the flesh of a dead animal: whether fresh or decayed is not stated, but from the human point of view, probably the latter. I have known them eat decayed buffalo and from the Ratel's point of view I see no reason why it should reject decayed humanity. Perhaps Mr. Champion will tell us why it should, and according to him does? The significance of my use of the word 'exhume' now becomes apparent. I have no direct evidence of 'eating' corpses, and in writing of animals of Central India I endeavoured to be as accurate as I could, especially so with regard to fact. I tried to avoid one step beyond which evidence would carry me. Whether the Ratel merely 'exhumes' the corpse for what he hopes to find associated with it, or for the purpose of eating it, I cannot say. My belief is both: but from Mr. Champion's own quotation about Ratel's unearthing dung in search of grubs, ample motive for unearthing a corpse can be inferred. Incidentally I take this opportunity to mention that it is due to dung dropping that one so frequently finds bears' excavations on paths and jungle roads.

Now for some evidence. During the rains, when one is more or less confined to headquarters, there was a colony of Ratels about 2 miles distant from my house on the bank of a considerable nala: lower down on the banks of the same nala, there was a native cemetery. The Ratels came under my frequent observation. One of their favourite excavating grounds was the cemetery and human remains were frequently exposed. Perhaps Mr. Champion will tell us where he has observed Ratels in the vicinity of a cemetery? and where they did *not* burrow in it? Ratels living in jungles like North Kheri have no opportunity of exhuming corpses. Duty once compelled me to spend a few days in camp in one of these miserable way-side stations on the main line near Harda. As usual there was no regular camping ground. My tents were pitched on the bank of a wretched nala. During the first night, infuriated dogs showed that some animal was prowling round. Daylight disclosed a large hole dug about 30 yards from the tent-door which exposed putrid human remains: part of the corpse was found some 30 yards further off in the bottom of the nala. The desecrater was a Ratel. Enquiry disclosed that some 2 months previously a very sick Mohammedan had descended from the train and was found dead next day on the platform. Whence he came, and who he was had not been discovered, so he was 'planted' on the bank of the nala, whence the Ratel subsequently excavated him. There is some of the evidence which can account for human remains being exposed by the Ratel, and I may add by asking how rarely the occurrence can come under interested, and intelligent observation?

It is a matter of some surprise to me that according to Mr. Champion local people in the United Provinces are unaware of the Ratel's existence as evidences of its presence were abundant. In the Central Provinces although Ratels dwell 'out', they nearly always have a base, usually an earth, sometimes hollow trees, rocks or a fallen bamboo clump. Animals which live in burrows usually require freedom from flooding and good drainage. Much of the North Kheri division, to which Mr. Champion refers more particularly, does not lend itself to burrows; possibly, in consequence, these are dispensed with.

There is no mystery about the Ratel's climbing abilities. Two Ratels used to inhabit the patch of jungle below the Telekeri Tank, at Nagpur, ¼ mile from the club. Any one interested may possibly still see their claw marks, just like a miniature bear's, on some of the trees: especially the end trees where the jungle narrows a to V before petering out. I used to surmise that they went up these trees to have a 'look-see' before entering the station.

It is impossible to say if the peculiar colouring of the Ratel has been specially developed for protective purposes. That it is protective it is hard to deny, especially in the face of the beautiful photograph published by Mr. Champion opposite page 56, and one would imagine more protective in moonlight than otherwise—especially to an animal which habitually quests in bare ground. The argument that the moon does not function continuously has only a very modified implication—protective colouring in animals does not necessarily operate under all conditions, all the time. It may develop to meet a particular hazard. It is gratifying to find corroboration of the Ratel's courage, as so far as I know I was the first person to draw attention to this attribute of the gallant little beast.

Ivy Bank, Elgin, N.B.,
Scotland.
June 24, 1934.

A. A. DUNBAR BRANDER.

III.—DEATH OF AN ELEPHANT (*ELEPHAS MAXIMUS* LINN.) WHILE CALFING.

On the 30th of last month my wife and I came on a cow-elephant that had just died while giving birth to a calf, a case of breech presentation. The elephant had apparently been lying there in great pain and had actually been shifted a few yards by other members of the herd in their attempts to help her up. An examination of the elephant showed that the breech and hind legs of the calf were born. While we were there another elephant came up within a few yards of us very silently. A day or two later I shot a wild dog feeding on the dead elephant's trunk. Some days after I observed that 5 King-Vultures were in full possession of the carcase while hundreds of their common kindred were perched on the surrounding trees. The herd remained in the vicinity for 3 or 4 days and were, from the volume of trumpeting and other vocal efforts, apparently disturbed over the whole affair.

I understand that a cow-elephant died under very similar circumstances on the borders of Pampadampara Cardamom Estate on the Cardamom Hills in Travancore last month.

The half-born dead calf was removed from its dead mother, under instructions from the local Forest subordinates I was informed. This is interesting in view of the prevailing Hindu custom in South India of extracting the dead body of a child from the corpse of a pregnant woman.

Honnametti Estate,
Attikan P.O., *Via* Mysore,
S. India.
April 25, 1934.

R. C. MORRIS, F.Z.S.

IV.—DEATH OF 14 ELEPHANTS (*ELEPHAS MAXIMUS* LINN.) BY FOOD POISONING.

I am indebted to Mr. A. Wimbush, the Chief Conservator of Forests, Madras, for the following information connected with the death of 14 elephants from eating Kodo millet known locally as 'Varagu'.

On the morning of 17th December, 1933, the villagers in the fields adjoining the Vannathiparai Reserve Forest came upon 11 elephants lying in the patta fields and 3 in the adjoining Reserve. By 3 p.m. in the afternoon the elephants in the fields were dead while the 3 in the Reserved Forest were obviously in a very bad condition and died later. The Veterinary Surgeon of Periyakulam conducted a post-mortem on two of the elephants and the viscera were sent to the Chemical Examiner.

Ripe 'Varagu' occasionally gets into a poisonous condition though its appearance then is no indication of this and the knowledge that the grain is fit for consumption is said to be gained by either cooking and tasting a very small quantity or observing the condition of the cattle during the threshing season. The antidote for the poison is said to be tamarind-water or buttermilk in large quantities.

Results of the chemical examination showed that the elephants had died from Kodo millet poisoning. It is reported that a similar case of elephants being poisoned by 'Varagu' occurred some years previously in a field in the same area. When this grain is in a poisonous condition it is apparently known as 'Kiruku Varagu'.

In the case of the 3 elephants that were found in the Reserve Forest the Range Forest Officer reported that water and tamarind fruit were supplied to them by the villagers and by this means the life of one of them was saved, but this is not confirmed.

HONNAMETTI ESTATE,
ATTIKAN P.O., *Via* MYSORE, R. C. MORRIS, F.Z.S.
S. INDIA.
May 22, 1934.

[The poisonous millet referred to by Mr. Morris as 'Varagu' is undoubtedly the millet known as *Kodra* or scientifically as *Paspalum scrobiculatum* Linn. The species is well known for its occasional poisonous properties and effects on man and beast. Dr. Mann writes: 'The grain as well as the straw of Kodra frequently, if not always, contains a poisonous narcotic principle which causes vomiting and vertigo. For this reason care is taken at least in the Konkan to prevent cattle straying into Kodra fields. The poisonous principle is probably produced under unfavourable conditions of climate and season and the grain and straw are only poisonous in particular seasons. It is said that . . . the narcotic property is to some extent neutralised by steeping in cowdung and water, or by keeping the grain for a number of years. Though the poisonous and non-poisonous grain cannot usually be distinguished by ordinary people, yet cultivators in Gujarat claim that the diseased grain can be detected while threshing as then the effects of the poisonous dust is felt both by the threshing bullocks and their driver.'

According to Dr. Lisboa the symptoms of poisoning resemble those caused by Datura and are severer in cattle than in man, due no doubt to the eating of the grain and husk and also to the absence of vomiting.—EDS.].

V.—SOCIAL BEHAVIOUR OF BISON (*BIBOS GAURUS* H. SMITH).

I was lucky enough last Sunday to be able to spend a considerable time watching the interesting behaviour of a herd of bison in their breeding season.

The Grass Hills above the Anamallai District run up to about 8,000 ft. and adjoin the Kanan Devan Hills of Travancore. They are very similar country to both these Hills and the Nilgiri downs. There is a considerable variation in altitude in our Grass Hills but the bulk of them are rolling grass land split up by streams and large and small sholahs.

At about half past eleven we were sitting on a ridge having a snack when we spotted a herd of bison about 1000 ft. below us grazing in the open between two sholahs. Through the glasses there was obviously nothing very big amongst them but a few minutes later two large bulls appeared on the edge of a sholah about a quarter of a mile behind the herd. One of them was doing a great deal of dancing about and demonstrating at the other and from subsequent examination of the ground they must have been scrapping out of sight of us for some time. The demonstrator was strangely enough the loser as presently he trecked off by himself and lay down on a small hill top right in the open a good distance away from any sholah whilst his opponent grazed his way towards the herd and joined them.

We watched the loser for some time but he made no attempt to move and looked so dejected that I came to the conclusion that he must have been badly damaged. My companion had never seen a bison before so we decided to go and have a look at him. It took us some time to get down to him and by the time we got there we could find no sign of him. Probably he winded us as this stretch of country is a mass of small round topped hillocks and the wind was all over the place as there were several thunderstorms going on down below us.

We then went on to have a look at the herd which had not shifted, and were moving about between two small sholahs and a patch of grass. This is unusual in this type of country in the middle of the day, as bison generally prefer to lie up in sholah, but the thunder may have made them restless, or possibly their restlessness was due to the fact that several of the cows were on heat.

We got well in and sat down to wait as it was impossible to move any further the intervening ground being absolutely bare with no dead ground.

The only members of the herd which remained permanently in the open were some six or seven calves of 2 or 3 months old. These calves were in the charge of a young bull who lay with them and moved with them whenever they moved. Incidentally the calves all lay together in a bunch and never attempted to straggle. Presently a young cow came out of the sholah and one of the calves got up and rushed at her for a drink. After being suckled for a few minutes it rejoined the others and the cow started to graze. A young bull not quite in his prime promptly tried to mount her but she would not stand to him. A few minutes later out came the victor of the morning's battle, a fine old jet black bull with very worn horns but a small head of not more than 35 in. He did not attempt to chastise the impertinent youngster who moved off well out of his way. There were at least four young bulls in the herd, in their prime but not as dark as he, and although they kept out of his way they appeared to graze quite happily with the herd.

In the course of the next quarter of an hour the master bull tried to mount two cows who were evidently not quite in season, and spent a good deal of time talking to himself and the world in general. This mating noise made by bull bison is best described as being very similar to that made by a domestic bull in a loose box when he hears the cows being driven out past his box door, only it is not so loud. It is delivered in much the same way as with a domestic bull with the head stretched out and slightly up, and the mouth just open. I have heard it used by a bull which had lain up some distance behind a herd and was hurrying to catch them up when they had grazed on in the evening. This was not in the mating season, so that perhaps it is wrong to call it a mating noise. It is quite distinct from the shrill bellow sometimes used by bull bison and which may easily be mistaken for an elephant's trumpet.

Now several interesting points arise out of this observation.

Bison in these hills drop their calves from about the beginning of March until the end of May which seems on the face of it an odd proceeding when the young calves, a few months old, have to face a very severe S.-W. Monsoon which has been known even in this district, two thousand feet lower, to register 80 in. of rain in a month. Occasional calves are born at other times of the year but the bulk are born within the three months mentioned. As the cows are now being mated this would put the gestation period at roughly 9 months or the same as domestic cattle.

The breeding season of bison evidently varies considerably with locality. There are plenty of calves to be seen in the bamboo and deciduous forests below us, round about Christmas time. I once watched a herd of bison in bamboo country for the whole of one day. The bulk of the herd lay up in a large patch of bamboo but one cow left them, and wandered off by herself, and eventually went into a small patch of bamboo about half a mile away at about midday. At three o'clock she came out with a new-born calf which was still damp. It could just walk very groggily but got almost visibly stronger every minute. The mother grazed quietly and slowly along just in front of it to join up with the herd again. This was at Christmas time.

There has been a considerable amount of controversy on the subject of solitary bulls. From my last Sunday's observation the master bull was of the type one would expect to find solitary at most times of the year. His opponent was I should say younger as he was not quite so dark in colour but there was nothing to choose in size. Size of head does not apparently necessarily mean victory, as this bull's head was small and from the worn state of his horns he had evidently been fighting for some years for his privileges.

It would seem that bison calves when old enough to be herded are discouraged from making a nuisance of themselves to their elders during the resting period of the day and are left in charge of a nurse. I have noticed this several times before, the nurse generally being a three parts grown young bull. Another point on which one hears and reads a number of different opinions is as to whether bison have dewlaps. From observation of a large number of bison there is no doubt that some have and some have not. The bull described above had one of the best developed dewlaps I have ever seen. I am inclined to think that dewlaps are often a family characteristic of bison inhabiting a certain district, but even this is not necessarily a certain characteristic.

Monica Estate,
Nalparai P.O.,
S. India.
June 7, 1934.

J. WILLIAMS.

VI.—GROWTH AND SHEDDING OF ANTLERS IN THE SWAMP DEER (*RUCERVUS DUVAUCELLI*) IN MANIPUR STATE.

Mr. Higgins has made over to me your letter of the 26th January making some enquiries about the Manipuri stag. I have no personal knowledge, but I have had enquiries made among men who are likely to know, and report as follows:

A. Time of shedding antlers—June and July.
B. Period when antlers are in velvet—August and September.
C. Period when clean—January and February.
D. Pairing season—March and April.
E. Time when young are born—October and November.

Imphal, Manipur State,
Assam.
April 9, 1934.

C. GIMSON.

VII.—HOOF DISEASE IN THE MUNTJAC (*MUNTIACUS MUNTJAC*).

The following account of a Muntjac may be of interest to you in as much as the feet were infected with some disease and the 'nails' came off! My dogs are not particularly brilliant and would not have caught him (a male) had it not been in a weak condition, although he was only about a third or half-grown. They caught him in the river in the estate and I thought at first it was an otter and I was all out for blood! When I realised what it was I ran to the rescue and was surprised to see several of the hooves had come off whilst the dogs were chasing him. I realised it was a sick animal so killed it and found the remaining hooves came off easily and had grown to an abnormal length. I don't know if it is a common disease and would be interested to hear if you have had similar cases.

Kurady Khan Estate,
Sangameswarpet P.O.,
Kadur District.
July 14, 1934.

G. V. R. FREND.

VIII.—NIDIFICATION OF THE TRAVANCORE LAUGHING-THRUSH [*TROCHALOPTERON JERDONI FAIRBANKI* (BLANF.)] AND THE BLACK-HEADED BABBLER [*RHOPOCICHLA ATRICEPS ATRICEPS* (OATES)].

In vol. i, p. 140 of Mr. Stuart Baker's *Nidification of Birds of the Indian Empire*, I see I am credited with finding my eight nests of the Travancore Laughing-Thrush in the month of March. This is of course incorrect vide my note in vol. xxxv, p. 204 of the *Journal*, all the nests with eggs or young having been taken between April 23rd and May 19th.

On p. 252 of the same volume Mr. Stuart Baker refers to my remarks on the Nilgiri Black-fronted Babbler wherein I stated that I was inclined to accuse these birds of nesting in colonies. On the same page he quotes Davidson who says 'It seems to spend most of its time building unnecessary nests'. This aspect of the case had not struck me. Davidson is perhaps right and I wrong, though it seems hardly likely that one or even two pairs of these birds would go to the trouble of building seven nests in a row. Further investigation into this point is obviously desirable.

Incidentally 'Mercana' should read 'Mercara', the capital of Coorg.

Shillong.
June 20, 1934.

W. BATES.

IX.—THE KING-CROW [*DICRURUS MACROCERCUS PENINSULARIS* (TICEHURST)].

In the Vernay Scientific Survey of the Eastern Ghats (J.B.N.H.S., vol. xxxvi, p. 348), it is said that 'the Survey did not procure specimens of the Black Drongo or Common King-Crow in the Vizagapatam area, but Ball cites Jeypore in his list of localities for it. It is probably generally distributed and resident down the whole of the eastern side of the Presidency. Though the only published records refer to Madras itself where Dewar has recorded some interesting notes on its habits (J.B.N.H.S., xvi, pp. 364-6 and 486) '. . . in the rest of the Presidency we certainly require more information about the King-Crow.'

I thought that the following will be of some interest. The King-Crow is one of the commonest birds in the Godavery District. It is always seen either perched on telegraph wires or riding easily on some lazy buffalo or cow. It is a very active bird, always on the wing, flying hither and thither and chasing away enemies far larger than itself—like that blackguard the Crow (whence its name) or even the Common or Pariah Kite. And it beats the lark in its early rising, I have heard the beautiful song of this bird as early as 2 in the morning, during the summer months. And it is equally a hard worker, foraging late into the evening even after sunset. The bird is of course most pugnacious when brooding and most active when bringing up its family. The young ones remain quite a long time with their parents even after the characteristic fork-tail is grown, obeying the harsh screech which is their danger signal and an alternative to their whistling song. Its diet seems to be mostly flies and butterflies and such other insects, but I suspect that along with the local people, it has a partiality for palm-juice or toddy. It either hawks butterflies on the wing or catches little insects from the crevices of palm fronds, and folds of buffalo-hide. In keeping with its royal nomenclature, it always affects the topmost and most conspicuous perch on trees—sitting well outside the foliage. Sitting on such a perch it surveys the land around to dart with lightning speed at some passing swallow-tail. It must surely be thankful to the Government Telegraph Department for erecting those perches without the encumbrance of leaves. Its grandest banquet is when termites emerge in large numbers from an ant-hill.

The bird builds its nest on any tree for it is not afraid of enemies. It selects usually Acalia trees in this district, but also builds on Rain and Tamarind trees. They brood with their forked tail stretching beyond the small cup-shaped nest. The parent birds brood in turns. The following is from my records.

24th April 1926		Discovered nest with 3 eggs; two large and one small egg.
29th, after 5 days		Birds sitting close.
1st May, after 8 days		Birds getting irritable.
8th May, after 10 days		The smallest egg hatched out.
14th May, after 17 days		All hatched, getting feathers.
22nd May	14 days after hatching	Still in the nest, tail feathers, appearing.
2nd June	25 days after hatching	Left the nest; within 100 yards of the nest; just able to fly a little. Tail not yet forked.
5th June		The family is progressing.
8th June	31 days after hatching	Being fed by parents still. Tail still short.

PRESIDENCY COLLEGE,
MADRAS.
April 3, 1934.

A. S. THYAGARAJU, M.A.

X.—NOTES ON THE HABITS OF THE MAGPIE ROBIN (*COPSYCHUS SAULARIS SAULARIS* LINN.).

The Magpie Robin is one of the most familiar birds in South India and yet there is very little mentioned about its habits in literature. A pair had taken up their abode in the front hedge of the S.P.G. Parsonage at Nangur, Tanjore District, South India, a village some twelve miles from Tranquebar. The distance between the Parsonage buildings and the gate is about 50 yards. The birds sang sweetly and occupied the fence on one side of the gate. In the last week of April this year my attention was drawn by the peculiar sound produced by the pair as they were trying alternately to strike at something about 40 yards from the house on the road leading from the Parsonage to the gate. It had rained the previous day and so I was inclined to think they were catching termites on the wing, but came out to see what the matter was. A green Whipsnake (*Dryophis mycterizans*) was seen on the road with its head raised in a posture ready to strike. The plucky little birds were able to prevent it from moving even an inch, till I despatched it with a stick. A Red-vented Bulbul (*Molpastes haemorrhous haemorrhous* Gmel.) was also in an agitated state hopping from branch to branch, raising its crest, and watching the attack but not feeling bold enough to join in it.

A week or ten days later my attention was drawn a second time by the birds which were producing the same alarming notes. On looking out I found the birds flying about hither and thither and frequently perching on a cocoanut palm on this side of the same road a few feet closer to the Parsonage from the spot where the snake was found. On closer examination an owl (*Strix flammea*) was found to be hiding at the base of the very same cocoanut leaf at the tip of which a Magpie Robin was sitting. The owl which had visited the bungalow during the night had failed to retire and the watchful eyes of the Magpie Robins were able to detect its presence. As they were unable to tackle the bird themselves they did the next best thing i.e., raising an alarm till those more powerful than themselves attended to their enemy.

The breeding season of the Magpie Robin appears to be from March to July. It may be that during this period the birds are more vigilant than at other times. Maternal instinct may force even a weak bird to protect its offspring from imminent danger, but attacking a snake on the road away from the hedge in which the birds had taken up their abode, coupled with their daring in approaching the tree on which the owl had hidden itself makes one feel that the birds are by no means cowards and that they possess the grit in them to put up a fight when the occasion demands it.

Wall, in the Bombay Natural History Society's *Journal*, vol. xxvi, p. 576, mentions an instance when he heard a prodigious hissing and discovered the presence of a black Cobra (*Naia tripudians*) through a window in a hedge, and adds that the 'prodigious hissing' proved to be the scoldings of a Magpie Robin.

Dogs are known to attack snakes and reveal their presence to man. My experience with regard to the Magpie Robin coupled with the instance mentioned by Wall, makes me feel that in this bird we have a friend who would inform us of the presence of snakes and attack them if it can.

Ever since the incidents mentioned in this note, I have observed the Magpie Robin more carefully. The Tailor bird (*Orthotomus sutorius sutorius* Forst.) has been reported to be a most confiding bird and it is stated that it frequently nests among the plants in one's verandah. This habit appears to me to be, not only an attempt to escape the depredations of carnivorous birds but still more a desire to court human protection. I have had the chance of noticing these birds in the presence of Magpie Robins. In another part of the Parsonage garden they lived in the same bush along with Magpie Robins and kept up a continuous 'Tweet'. During the day they were seen in various places in the compound and were always along with the Robins. When they flew away the Tailor birds followed them. This I have noticed for over a month. The explanation for this comradeship appears to me to be that the weak Tailor birds court the protecting care of the more daring Magpie Robins. They retire in the same bush and move always together, the Magpie Robins leading.

The Tamil name for the Magpie Robin is *gundoo-karitchan. gundoo* means round, and *karitchan* is the Black Drongo (*Dicrurus macrocercus macrocercus* Vieill.). It is possible the Tamilians call it *gundoo-karitchan* because the bird looks round when the tail is lifted up and will look like a Drongo if it is black completely. The pugnacity of the Drongo is well known. It drives away carnivorous birds but weaker birds nest in the same tree and count on the protection it can afford. It is possible that a situation similar to this is found in the association of the Tailor bird and the Magpie Robin though to a less extent.

Whether the name *gundoo-karitchan* has risen as the result of the observation of the Tamilian who has seen the bird attack other birds, I have not been able to find out, but I dare say the Magpie Robin would have attacked the owl when I saw it, but for the protected position the owl occupied.

These notes are communicated in the hope that others may be able to record similar experiences.

'Niton', Letangs Road,
Vepery, Madras. BONAVIS BONNELL.
July 21, 1934.

XI.—THE NESTING HABITS OF THE SMALL SUNBIRD [*LEPTOCOMA MINIMA* (SYKES)].

On the 5th February, 1934, I observed a pair of these pretty little birds building a nest in my garden at the tip of a slender branch of *Mimusops elenghi*, under an awning of leaves, at a height of about 10 ft. from the ground. The nest has made some progress by that time, so that, it was obvious that it must have been begun earlier. It was suspended from the tip of the branch, and was more or less domeshaped, with a circular opening on the treeward side overhung by a hood, apparently meant as a protection against the inclemencies of weather and unwelcome intruders. The nest was made of lichens, fibres, and such other materials.

On the 5th and 6th February, the male was doing all the work, but, on the 7th morning, I observed the female busy working at the nest. The male was merely flying to and fro, covering the female in its flight to get the materials for, as I discovered, lining the nest. The lining was arranged, first with the beak, and then with the feet, the bird entering the nest for the purpose. Almost every time fresh material was brought the process was repeated alternately with the beak and legs. The same activity was observed on the part of the female on the two succeeding days, the male, as before, covering its mate in its flight. The nest building activity was particularly noticeable in the morning on all these days.

On the 10th and 11th I did not see these birds. They appeared to me from the very beginning exceedingly nervous and suspicious. I was wondering whether they had deserted their nest, seeing that they were being watched. To my relief, they were seen again on the 12th morning at about 9 o'clock. The female came to the nest only once or twice. It was evident that the nest had been completed. My observation shows that the coarser part of the work of nest construction, the building of the body, is allotted to the male, the finer part of it, the lining, being undertaken by the female, which, naturally knew better than its mate the requirements of the eggs and nestlings.

At 2 p.m., on the day in question, I saw the female bird alone coming to the nest. It entered the nest and sat inside putting the head and beak out through the opening, which was eminently shaped for the purpose. The male bird could not be seen anywhere in the neighbourhood. The behaviour of the female led me to suspect that it had laid eggs, and when, taking advantage of the bird's temporary absence, I examined the nest at 4-30 p.m., my suspicion was confirmed by the presence of two small dirty white eggs. I had examined the nest the previous evening. There were no eggs then, and there was no doubt that the eggs were laid only this day, i.e. 12th Feburary. The female bird came to the nest almost immediately I finished my inspection of it, and after about 15 minutes, flew away. A little after 5 p.m. I saw the male for a very brief while, sitting on a neighbouring branch of the tree.

From the 13th to the 22nd of February, I saw the female sitting in the nest on and off, the male not being visible anywhere in the neighbourhood. On the 23rd at about 9 a.m. I saw the male again coming with the female. The male bird sat on the branch of a neighbouring tree for a very short while and then flew away. On the 24th the attention of the male became more assiduous. The pair could be seen very often flying together and hovering about the nest. Once I saw the male actually putting its head into the nest. The behaviour of the male, on the whole, gave the impression that some great event was impending, and that event could be none other than the hatching of the eggs. This sort of attention on the part of the male continued on the following days, and, every evening I examined the nest to see if the hatching had taken place. On the 1st of March, at about 5 p.m. I saw the pair visiting the nest. I suspected them to be feeding or 'fondling' the nestlings, and the examination of the nest showed that the eggs had been hatched. The incubation period extended from the 12th February to the 1st March, about 18 days.

I found that, although the male visited the nest now and then the feeding and practically all care of the nestlings devolved on the female. I had hopes of seeing the nestlings in their first efforts at flight, but these hopes were not destined to be realised. Unusual for that part of the year, there were a few sharp downpours from the 15th to the 18th March, and as I was otherwise busy on those days, I do not know what happened to them during that period. But certain it is that on the 18th evening, when I examined the nest, which was partly damaged by the rains, I discovered to my great discomfiture that the nestlings were no longer there. I have not seen them or their parents since.

Maharajah's College,
Ernaculam. K. KARUNAKARAN NAYAR, M.A.,
April 4, 1934. *Professor of Zoology.*

XII.—HABITS OF THE KING-VULTURE (*SARCOGYPS CALVUS* SCOP.).

Mr. Ali writing on the habits of the King-Vulture in his recent paper (Hyderabad State Ornithological Survey, vol. xxxvii, p. 425) holds views opposite to those of most ornithologists who preceded him. He says that he has found 'this so called King-Vulture, to be the most cowardly member of the fraternity that usually gathers to a feast, keeping himself aloof from the scrimage, only venturing forward in obvious fear and trembling to tug at a gobbet and withdrawing hurriedly when overwhelmed by the press'. Obviously a case of *lèse majesté*—which suggests a development among Vultures of the modern disregard for the divine rights of kings.

Mr. Morris in his note on the death of an Elephant when calfing, published on page 722 of this number says that he observed five King-Vultures in 'full possession of the carcase while hundreds of their common kindred were perched on the surrounding trees'.

From this one might gather that the disaffection has not spread through all parts of the country—and that there are places where the King-Vulture's claim to supremacy remains undisputed.

Bombay Natural History Society,
Bombay. EDITORS.
August 16, 1934.

XIII.—A NOTE ON THE APPENDAGES AND BARBS ON THE WINGS OF THE PHEASANT-TAILED JACANA [*HYDROPHASIANUS CHIRURGUS* (SCOP.)].

Mr. W. A. Hewitt of Bihar in his letter to us with regard to the appendages and barbs on the wings of the Pheasant-tailed Jacanas obtained by him says: 'I have examined four immature specimens of the Pheasant-tailed Jacana and in every one of the four birds I found that the first and second primary were produced into a filamentous lanceolate appendage, and the fourth into an attenuated point.'

Mr. Hewitt suggests that the present Fauna of British India is wrong, as are many other books on Indian Ornithology, in assuming that only the first primary ends in a filamentous lanceolate appendage.

On going through the large series of *Hydrophasianus chirurgus* in the Society's collection I find that the present Fauna and all other books on Indian Ornithology seem to have described the Pheasant-tailed Jacana from the first bird at hand.

The characteristics displayed by the wing appendages in Mr. Hewitt's specimens are only confined to immature birds. As the bird grows older, the webs fall off or disintegrate, leaving a featherless barb. The third primary loses its web first, then the second primary and finally, in very old birds, the first.

Mr. Hewitt's observations have led us into other channels. I find that the absence or presence of webs on the primaries gives an indication as to the age of the bird. The older the bird, the less are the webs and even barbs on the primaries. In one old male bird's skin, in the Society's collection, there are no evidences of barbs or webs on any of the primaries. The only constant feature in all birds is the attenuated point in the fourth primary.

BOMBAY NATURAL HISTORY SOCIETY,
BOMBAY.
May 5, 1934.

V. S. LA PERSONNE,
Assistant Curator.

XIV.—OCCURRENCE OF THE WOOD SNIPE [*SCOLOPAX R. RUSTICOLA* (LINN.)] IN THE CENTRAL PROVINCES.

I enclose the wing of a Wood Snipe shot in the Balaghat Division of the Central Provinces on the 25th February presumably while migrating.

The place and date may be of interest.

RAIPUR, C.P.,
March 3, 1934.

P. V. CHANCE.

XV.—A FURTHER AID TO DIFFERENTIATION BETWEEN SWINHOE'S SNIPE [*CAPELLA MEGALA* (SWINHOE)] AND THE PINTAIL SNIPE [*CAPELLA STENURA* (BONAPARTE)].

The similarity in the colouration of Swinhoe's Snipe and the Pintail Snipe frequently leads to confusion of the two species by sportsmen.

The key to the identification is given as:

Tail features 26 in number, never less than 22	*C. stenura.*
Tail feathers 20 in number	*C. megala.*

The above seems ample enough to identify either bird, except when the tails are in moult! Mr. Gimson recently sent us two skins of snipe which he thought were Swinhoe's, on the strength of them not showing any pin-feathers in the tails. Both birds were in heavy tail-moult, and except for the partly-grown 4 central tail-feathers the rest were mere stumps of one millimeter or less. With the aid of a magnifying glass it was possible to count these stumps, which numbered 22. They were therefore the Pintail Snipe.

In the absence of the most essential features of differentiation between these two birds, I have found, on examining the series in the Society's collection, that there is one constant feature which will be an aid to differentiation between these two snipes. The following key was sent to Mr. Stuart Baker for verification.

Longest feather in bastard: wing never under 20 mm.	*C. megala.*
Longest feather in bastard wing never over 17 mm.	*C. stenura.*

Mr. Stuart Baker has sent the following letter:

'You are quite right about the bastard wing of *C. megala* and *C. stenura* and I find my notes say—Bastard wing of *C. megala* (Swinhoe's) never under 20 mm.; that of *C. stenura* (Pintail) never over 18 mm.

A very good key would be:

A. Bastard wing always over 19 mm. ...	*C. megala.*
B. Bastard wing always under 19 mm. ...	*C. stenura.*'

In view of the little known habits and distribution of Swinhoe's Snipe and the possibility of it being overlooked in large bags, the above key it is hoped will help sportsmen towards a correct identification in the future.

Bombay Natural History Society,
Bombay.
May 25, 1934.

V. S. La PERSONNE,
Assistant Curator.

XVI.—OCCURRENCE OF THE PURPLE WOOD-PIGEON [*ALSOCOMUS PUNICEUS* (TICKELL.)] IN SINGHBHUM DISTRICT, BIHAR AND ORISSA.

I am sending you two skins of what I believe to be Purple Wood-Pigeon (*Alsocomus puniceus*) shot in the Saranda forest division of Singhbhum district on the 12th May.

Speaking from memory, I think the only record of the occurrence of this bird is that of Col. Tickell, referred to in Stuart Baker's 'Indian Pigeons and Doves'. Tickell was Deputy Commissioner of Singhbhum sometime in the 'fifties and I have heard of no other reference to the bird's existence in the district. For some years past I have endeavoured to verify the original record in Singhbhum and the adjacent States of Orissa, but hitherto without success.

It appears that this pigeon is not alone very rare but is extremely local; although where I encountered it I saw no less than thirty or forty birds. They inhabit a few cool valleys at about 2,000 ft. elevation in *sal* forest characterised by a dense evergreen undergrowth consisting mainly of *Litsaea nitida* and *Symplocos spicata*, and watered by fresh perennial streams. The local people, Hos, know the bird as *gara putam* and say that it is never found outside three or four high valleys where this type of forest is met with.

When found by me the birds were congregated feeding on the unripe fruits of *Litsaea nitida;* and the crops of both specimens shot were full of the berries. The birds were not particularly shy and kept moving in short flights as I followed them: soon settling down to feed if not approached too close. Their flight is not very rapid, rather resembling that of the Green Imperial Pigeon; and their call is also rather similar to that bird, though the note is not so low nor so prolonged.

I have not heard of the occurrence of this bird elsewhere in the province but I should think it not improbable that it might be found in the higher hills of Mayurbhanj and Bonai States, the latter adjoining Singhbhum on the south.

The Green Imperial Pigeon does not appear to occur in this district or elsewhere in Chota Nagpur; although I have seen it forty miles further south and thence throughout the forest tracts of Orissa to the northern borders of Madras.

Camp Tholkobad,
Singhbhum District.
May 14, 1934.

H. F. MOONEY,
I.F.S.

XVII.—THE DAWN CAROL OF BIRDS.

Observations of the dawn carol on April 17th, 1934.

At 10 minutes to 5 a.m. the Mynas began to make a noise. They stopped it for 10 minutes and then began again and stopped after 15 minutes.

The Jackdaws (*Corvus monedula sommeringii*) joined in.

At 5-20 a.m. Tickell's Thrush began its song and was joined in after a few seconds by the Great Tit.

Sparrows took part in it and the concert was in full swing until 10 minutes to 6 a.m.

Then there was a silence.

This place of observation is east of Srinagar towards the lake side.

On May 28th.

At 4-35 a.m. The silence was broken by Mynas, 10 minutes after, rose the song of Tickell's Thrush and was followed by the Golden Oriole's song. By this time the concourse of finches was great. The Ringdove lifted its note and the short and pleasing warble of the Paradise Flycatcher and the singing of the Bulbul added more tunes to the morning song. The Great Tit joined in and the Hoopoe was the last bird to join the concert.

The song died away slowly at 5-35 a.m.

The sun rose at 6-10 a.m.

On June 3rd.

Observations were taken in a boat on the Dal Lake near Srinagar.

During the night we heard several deep 'wak' calls of a Heron (Night Heron or Common Heron). At 3-55 a.m. the silence of the dawn was broken by Tickell's Thrush and was soon after joined in by the Golden Oriole. I could not recognise the shrill call of some bird coming from a poplar tree. At 4-30 a.m. the Great Reed Warbler (*Acrocephalus stentoreus*) joined the chorus.

The chorus slowly died away.

The sun rose at 6-10 a.m.

The following observations of the serial succession of bird songs at dawn were taken on 4th June at Srinagar in the gardens of the Rev. Canon Tyndale-Biscoe and Mr. F. Jacob, which are adjacent to each other. The gardens are full of plant life of almost all dimensions from small bushes to tall stately trees and present the aspect of a forest or woodland interspersed here and there with lawn. The place is a bird sanctuary. What a joy it gives to an early riser to hear the sweet symphony into which in all probability he merges his own soul!

TIME	NAME OF THE BIRD	REMARKS
4-15 a.m.	Tickell's Thrush (*Turdus unicolor*).	This bird began with a sweet and soft note.
4-21 a.m.	Do. do. ...	More than half a dozen joined the chorus with high notes.
4-30 a.m.	The Golden Oriole (*Oriolus oriolus kundoo*).	
4-32 a.m.	The House Crow (*Corvus splendens zugmayeri*).	This bird gave only two calls (caw).
4-35 a.m.	The Golden Oriole ...	
4-40 a.m.	Do. ...	The second bird.
4-45 a.m.	The Ringdove (*Streptopelia decaocto decaocto*).	
	Sparrows (*Passer domesiticus parkini*).	
	The House Crow ...	Second time.
4-50 a.m.	The Ringdove ...	
4-51 a.m.	The Ringdove ...	Second from a different quarter. Third.
	The Bulbul (*Molpastes leucogenys leucogenys*).	
	The Great Tit (*Parus major kaschmiriensis*).	
	The Mynas (*Acridotheres tristis tristis*).	
5-0 a.m.	The Ringdoves ...	Sometimes by turns, sometimes together.
5-1 a.m.	? ? ?	
5-10 a.m.	The Paradise Flycatcher (*Terpsiphone paradise leucogaster*).	Joined the concert.
5-11 a.m.	Tickell's Thrush ...	Alighted on the lawn to feed. Chorus began to melt.
	The Mynas ...	Noise.
	The sun rose at 6-5 a.m.	

Dr. Brut observed the Himalayan Cuckoo's song at 3-50 a.m. at Islamabad 35 miles S.-E. of Srinagar.

C.M.S. HIGH SCHOOL,
SRINAGAR,
KASHMIR.
June 19, 1934.

S. C. KOUL.

XVIII.—THE MIGRATION OF WILD FOWL, THE SOCIETY'S BIRD RINGING SCHEME.

Since the publication of vol. xxxvi, No. 2, two recoveries of Ringed Birds have been reported by the Director, The Bird Banding Bureau of Moscow, 13 Argo-biostation, Moscow.

One recovery of the Glossy Ibis (*Plegadis falcinellus falcinellus*) ringed in U.S.S.R. was recovered by Capt. Wright at Deolali.

Place Ringed.	No.	Date Ringed.	Species.	Ringed by	Date Recovered.	Locality.	Remarks
Manchar Lake.	3354	23-1-29	*Chaulelasmus streperus.* ♀ (Adult)	R. B. Maclachan.	9-3-31	Ust-Yuish Region. 54°5′ E. L. and 64°20′ N.L. U.S.S.R.	
Manchar Lake.	2673	25-1-29	Mercara Penelope Adult. ♂.	R. B. Maclachlan.	7-5-29	Village Yary Lino. Region Kalpach Evsk. Circuit Tomsk. W. Siberia.	
Astrakhan Volga Delta	3929 D.	7-7-31	*Plegadis f. falcinellus.* (Juvenile).	Bird Banding Bureau Moscow.	14-3-34	Dodlali.	The distance flown is roughly 2,800 miles.

Bombay Natural History Society,

Bombay.

EDITORS.

August 16, 1934.

XIX.—ANGLING OF CROCODILES.

In Kottayam, a village near Tellicherry, North Malabar, there is a large pond which is an abode of hundreds of crocodiles. It is not exactly a pond as the dimensions are so big that it can be termed a lake. Once I happened to see some people engaged in capturing a crocodile.

Their method of catching these animals is mainly by angling. In the place of a float, used in fishing, two pieces of plantain-tree stems two or three feet in length tied together served as the float. To this float is firmly fixed an iron hook which is similar in shape to the ordinary fish-hook but has more barbs and is as big as the handle of an umbrella.

The float together with the hook attached, is floated to the centre of the lake by a man in a small canoe. He fixes a moderately large piece of flesh to the hook. The hook is so fixed to the float that the piece of flesh just touches the water. The man then leaves the whole thing there and returns to the bank. The free end of the rope is held by the people on the bank.

After a while a crocodile comes out and takes the bait. The barbs fasten to the floor of its mouth and the helpless reptile struggles vainly. Now the men on the bank holding the rope pull it towards the land. They drag it out of water and beat it to death. This method of catching crocodiles is familiarly known in the vernacular as *Kalam*.

GOVERNMENT MUSEUM,
MADRAS.
July 18, 1934.

T. V. SUBRAHMANIAM, B.A.

XX.—NOTES ON THE INDIAN MONITOR (*VARANUS MONITOR*) AND FLYING LIZARD (*DRACO MACULATUS*).

I am sending you under separate cover the skin of a lizard for identification. I am pretty sure in my own mind that it is a small specimen of the Common Monitor Lizard which is fairly common in the Hills (the Anamallai Hills) but is not often seen. This particular specimen was noticed wandering about the verandah of a stone-built bungalow and was killed in the bedroom of the wife of the owner of the bungalow. As a matter of interest I should be glad to know whether the diet of this lizard is known to include ants. This particular bungalow and garden is infested with millions of the small black ant and also has a goodly sprinkling of white ants. The bungalow servants and also the office staff were emphatic that the lizard was not a monitor the Tamil name for which is *udumbu* but stated that it was a lizard that lived on ants by sticking out its tongue to which they stick. I fancy they were guessing at its habits, but there was a curious persistence of the tale that there were three kinds of lizard like the Udumbu—this one being an ant-eater. The local jungle tribes and also most of our outcaste labour forces from the plains are very fond of the Monitor Lizard as a delicacy. When caught they do not as a rule kill them outright but break all their legs and tie them into knots like a whiting. The lizard is then cooked alive in its skin at leisure, a hideously cruel habit but possibly not much worse than the usual methods of cooking lobsters, prawns or shrimps.

I once caught a Monitor Lizard when tracing a road through the middle of a 300-acre clearing of evergreen jungle which had just been burnt. This lizard had lived right through the fire and except for a few burnt toes which snapped off on being pressed and a small fire scar near the tail was unhurt and in good condition. When it is realised that it is not possible to get into a burnt clearing for 3 or 4 days after the burn and that even then one is apt to find boot-soles burnt through after the day's work it seems incredible than anything could live through the fire.

Whilst in Bombay in December I mentioned the matter of a flying or gliding lizard which is fairly common here to Mr. Prater I should be glad to know whether the society has any specimens. Should there not be any specimens in Bombay I will try and collect some although they are very difficult to catch as they seem to spend most of their life at the top of tall trees. I had the opportunity of observing a very fine and unusually large specimen at fairly close quarters last week. It happened to finish a glide on the side of a dady tree close to me and I watched it make a leisurely way up the tree. I have noticed before what I took to be the shooting out of a long tongue as the animal travels up a tree, which shows up a bright yellow colour in the sun. On this occasion I was close enough to see that this is not a tongue at all but a small auxiliary parachute web on both sides of the neck immediately under the head which shows up a bright yellow colour when the sun shines through it. This web is expanded and contracted at frequent intervals as the lizard climbs the tree and except at close range would be mistaken for the tongue. The main parachute along the ribs remains folded and unnoticeable, in the same way as a cobra's hood, when the lizard is climbing.

Colonel Fraser, I.M.S., from Coimbatore caught a fine specimen about this time last year when hunting for dragon-flies up here. He told me that he had set it up and was I believe going to send it to you.

MONICA ESTATE,
VALPARAI P.O.,
S. INDIA.
April 18, 1934.

J. WILLIAMS.

[The skin sent by Mr. Williams was that of the Common Indian Monitor (*V. monitor*). The lizard referred to is the Flying Lizard (*D. maculatus*), a specimen of which was subsequently received.—EDS.].

XXI.—NOTES ON INDIAN MONITORS IN THE UNITED PROVINCES.

I am afraid that I have never made much of a study of lizards and my information on the subject is sketchy.

In the four divisions I know well—Lansdowne, Dehra Dun, North Kheri and Bahraich—large lizards of all kinds except crocodiles appear to me to be distinctly scarce, although there are many species of small lizards. There used to be a fair number of *Goh*

(*Varanus monitor*) at Nauri in Lansdowne but they seemed to get scarcer year by year. In Dehra Dun and North Kheri I only came across odd specimens at fairly long intervals and in Bahraich I have not so far seen a single one. *Varanus flavescens* may occur in water-logged areas in Bahraich, but if it does, it must be uncommon as nobody here seems to know anything about it and I have personally seen none at all. There used to be large numbers of an iridescent greeny-blue lizard that lived on stone walls in Lansdowne. This reptile was up to 2 ft. long and I don't know its scientific name, but the 2nd/20th Burma rifles came to Lansdowne Cantonment and their men captured and ate practically the whole lot. This battalion has now left the cantonment and the species may be recovering again, but from being very common it had become scarce when I left there in 1929. The Burma rifles may also have been the cause of the disappearance of *Varanus monitor* from Nauri.

I do not know accurately the position as regards the abundance or otherwise of *Goh* in divisions where I have not been posted, but I am under the impression that they are not particularly common anywhere inside reserved forests. The breeding season is not absolutely definitely known but it is almost certainly late in the hot weather or at the beginning of the monsoon.

In view of the fact that *Goh* are not generally particularly common inside reserved forests and that a merciless campaign against them is being waged in many places outside the forests where control is much more difficult, may I suggest that, instead of trying to enforce a close period for an uncertain breeding season, we should forbid the *commercial* exploitation of lizard skins altogether from reserved forests? I mean by this that Divisional Forest Officers should not give permission for any one to capture lizards with the object of selling their skins from anywhere inside the reserved forests. This will not result in any loss or interfere with the present trade in lizard skins, and the few *Goh* that we have will thus be protected and form a reservoir from which a certain percentage will certainly stray outside and probably be captured.

It is sometimes said that *Goh* are destructive to the eggs of Jungle Fowl and Kalej Pheasant. I do not know definitely how far this is true but it is a fact the Nauri in Lansdowne division is the best place I know for Kalej and it is (or rather used to be) also the best place I know for *Goh*. It may be that because *Goh* eat Kalej eggs, they used to collect at Nauri, but in any case the stock of Kalej there did not seem to suffer from their depredations. With the limited number of *Goh* that we have inside reserve forests I do not think the question of their possible destructiveness to game-birds need be taken into consideration.

I am afraid that this is not a very valuable note but I will try to collect some more information on the subject.

F. W. CHAMPION, I.F.S.

DIVISIONAL FOREST OFFICE,
BAHRAICH DIVISION, U.P.
June 15, 1934.

XXII.—OCCURRENCE OF THE SIX-TOED FROG (*RANA HEXADACTYLA* LESSON) IN THE BOMBAY PRESIDENCY.

On the 25th February this year in company of Mr. H. Ali and his cousin, I visited the Karnala Fort (Funnel Hill in the Kolaba Dist. While in quest of natural history specimens I noticed some frogs in one of the rock-cut reservoirs. At first I took them to be the ordinary Water Skipper (*Rana cyanophlictis* Schneider) but they appeared larger and heavier in build and did not skim the water in elegant 'skipper style'—the jumps were more laboured and not so long. Not having a net I shot two of them as they floated on the surface. They immediately sank to the bottom from where Mr. Ali was fortunately able to retrieve them, as they were only wounded.

Once they were in my hand I immediately recognised that they were not the Water Skipper but the Six-toed Frog (*Rana hexadactyla*). On examination both proved to be gravid females. The eggs were well advanced and would have in all probability been deposited in a short while. It is curious that these frogs should be gravid at this time of the year, but this might be explained by their totally aquatic habit in which case they may possibly breed the year round when favourably situated. The cisterns have water all the year round. It is interesting to note that the frogs were commoner in those cisterns which were exposed to a certain amount of sunlight—the frogs would bask in the sun as they floated. Karnala is 1,560 ft. high.

As far as I am aware this constitutes the first record of *Rana hexadactyla* in the Bombay Presidency.

Subsequent to this discovery, Mr. Ali brought me a single immature specimen which he secured under stones in a pool of a drying nulla at Apsoli, Alibag, Kolaba Dist., on the 12th May of this year.

Possibly this species is not at all rare in the Presidency but has been probably mistaken for its cogener *Rana cyanophlictis* which it closely resembles.

BOMBAY NATURAL HISTORY SOCIETY,
BOMBAY.
October 16, 1934.

C. McCANN,
Assistant Curator.

XXIII.—OCCURRENCE OF LEITH'S FROG (*RANA LEITHII* BOULENG.) IN SALSETTE ISLAND.

On the 14th October this year I secured three specimens of *Rana leithii* at the Kanari Caves (1,300 ft.), Salsette Island. In my paper *Notes on Indian Batrachians* (J.B.N.H.S., xxxvi, 167), I recorded this rare species from Khandala, Western Ghats. One of the specimens was caught as it was crossing some dry rocks, the other two were found in damp places near some of the rock-cut cisterns. The one crossing the rocks was pale yellowish brown, much like the Khandala specimens, but those caught near the cistern were dark brown (they all turned pale on preservation) simulating the colour of the rocks. A blackish band extended along the upper mandible to the tympanum. The skin was covered with small warts particularly in those which were caught at rest near the cisterns.

This frog is extremely active in its movements and is able to take considerable jumps particularly when disturbed, but tries to hide itself at once.

The Kanari Caves is apparently a good ground for Amphibians as I have taken some of the rarer species in the locality.

BOMBAY NATURAL HISTORY SOCIETY,
BOMBAY.
October 16, 1934.

C. McCANN,
Assistant Curator.

XXIV.—RAT-SNAKES AND THEIR FOOD VALUE.

Rat-snakes (*Pytas mucosus*) are commonly eaten in some parts of North Malabar. They call it by the name *Paramba vala* or *Kara vala* thereby meaning in English 'Land eel'. The term 'eel' applied to a snake is surely misleading but it must be due to the external resemblance in shape that they call it so.

Two or three men surround a snake and catch it with their hands. Then they pull the animal through a hole in a cocoanut shell in such a way that the tail end passes through the hole first. By so doing the animal is not only killed but its scales also removed. The head portion is cut away and the rest is used as meat.

GOVERNMENT MUSEUM,
MADRAS.
July 18, 1934.

T. V. SUBRAHMANIAM, B.A.

XXV.—EFFECT ON MAHSEER OF EATING THE FRUIT OF THE KALAW TREE (*TARAKTOGENOS KURZII*).

There are numerous species of mahseer found in Burma. The commonest Burmese names for mahseer are *nganangyaung*, *ngathalein* and *ngatauk*. A very widely-spread belief prevails among Burmans that mahseer caught in streams which flow through certain evergreen forests are poisonous if eaten. Mahseer when found in such streams are called *ngatauk*. The poisonous effect is said to be due to the fish eating the fruit of the *kalaw* tree. If any one eats a mahseer from such a stream it has a delirious effect as the name '*ngatauk*' implies. '*Nga*' means fish and '*tauk*' means to be giddy. Two streams where the mahseer are 'poisonous' in this way are the Kodan and the Nankamu in the Upper Chindwin District. These streams are left bank tributaries of the River Chindwin; they flow through dense evergreen forest in which the *kalaw* tree is plentiful. There are other tributaries of the Chindwin River in which mahseer are also called *ngatauk*. Here also the fish are said to be poisonous, but most of the streams draining the right bank of the Chindwin flow through ordinary deciduous forests; the fish from these streams are edible and in these streams mahseer are locally called *nganangyaung*.

U Pe Kin, Extra Assistant Conservator of Forests, while working near the Nankamu stream was told by the local inhabitants that the flesh of the *ngatauk* from that particular stream was very poisonous. He did not believe what he was told and ate one of these fish. He became seriously ill. He says that the effect was similar to that of drinking country spirits—'I felt very giddy and slightly delirious. . . . Many of the Chin coolies ate the fish and they all suffered in the same way. One of the Chins died two days later. The Chins said it was the fish, but after making enquiries it was found that he ate only a small quantity. The death was in my opinion due to pneumonia.'

U Pe Kin, in the course of his researches on this subject, has eaten *ngatauk* from streams on either bank of the Chindwin and he is now convinced that what the jungle Burmans say is correct, namely that it is only the fish found in streams which flow through forest in which the *kalaw* tree is plentiful that are poisonous and he has come to the conclusion that the local Burmans have two names for the same fish namely *ngatauk* in streams flowing through *kalaw* jungle and *nganangyaung* in other streams.

A European Assistant of a firm of timber lessees was seriously ill some years ago due it is said to eating a mahseer caught in the Kodan stream.

The oil derived from the fruit of the *kalaw* tree has valuable properties. It is used very largely in the treatment of leprosy.

MAYMYO. S. F. HOPWOOD, I.F.S.,
June 7, 1934. *Chief Conservator of Forests, Burma.*

[J. F. Rock writing on 'The Chaulmoogra Tree and some related species' in United States Department of Agriculture Bulletin, No. 1057, p. 18, says:

'Bears also (author has previously referred to Monkeys) are very fond of the fruit flesh, and large numbers of them roam the forests in search of kalaw fruits. . . . The heavy rains wash the large and often buoyant seeds into the creek and thence into the Khodan stream, the fish of which feed on them. The natives stated that they dare not eat any fish from the Khodan stream, as it would produce the same effect as the eating of a number of fresh kalaw seeds. Wild pigs are also fond of the seeds, and the natives refrain from eating pork at the kalaw fruiting seasons, as the flesh of pigs which have fed on kalaw seeds is poisonous, producing nausea and vomiting.'

'It is well to bear in mind that the seeds of all these species (of *Taraktogenos* and *Hydnocarpus*) so far examined have been found to contain cyanogenetic glucosides, which liberate small quantities of prussic acid when the seeds are ground up in a moist condition, and that the oils they contain are toxic. It is on record, for example that a Hydnocarpus oil imported into Hamberg in 1911 and used for the manufacture of edible products gave rise to poisoning cases'—Kew Bulletin (1926), p. 20.—Eds.].

XXVI.—A HUNTING WASP ATTACKING A SPIDER.

Apropos of the story of the Hunting Wasp and Trapdoor Spider, published on pages 239 and following of your *Journal*, issue dated the 15th April last.

In a jungle of the Central Provinces I once saw a large spider racing over a bare patch of dried earth, pursued by a big emerald and green wasp. When the wasp swooped down on the spider, the latter flung itself on its back, and held the wasp 'at arms' length, the wasp trying in vain to reach the spider with its sting. The spider then threw off its enemy and made another bolt for safety. Down came the wasp again and again the spider repeated its former tactics. This happened, as far as I remember, three or four times, until, in a last lap, the spider gained a crack in the ground and the wasp retired, defeated.

Udaipur, Mewar. C. G. CHEVENIX TRENCH.
May 12, 1934.

XXVII.—SOUND PRODUCED BY TERMITES AT WORK.

Col. F. P. Connor's note in the *Journal* on page 1018 (vol. xxxvi, No. 4) on 'Rhythmic sound produced by Termites at work', reminds me of a similar observation I made, while at Peddapuram, a town about ten miles north of Cocanada. This place is famous for its large white-ants, known as *Gorre-chedalu* in Telugu. They build huge ant-hills inside dark rooms. Their presence is usually known by a burring sound, and that is a sign that our best books are being devoured. This sound is quite distinct and is audible even in the daytime, for these termites work at all times provided the place is dark. The sound may be compared to a harsh grating noise *bur bur bur*, indeed the name *Gorre* is I imagine an attempt to indicate it.

Presidency College,
Madras. A. S. THYAGARAJU, M.A.
February 28, 1934.

XXVIII.—A CENTIPEDE KILLING A MOUSE.

My family, servants, and I witnessed an extraordinary sight this morning at 8-30 a.m. and that was a 6 inch red centipede kill a full grown mouse inside a fruit basket containing green mangoes. The centipede held both hind legs of the mouse so that it could not move and buried his legs along the length of its body and fixed his nippers or whatever they are called in the mouse's neck killing it in about five minutes. We had heavy rain last night and that must have driven the centipede into the verandah and the basket.

L. D. W. HEARSEY,
Captain.

HARIPUR P.O.,
KHERI DISTRICT, U.P.
June 6, 1934.

WILD ANIMALS OF THE INDIAN EMPIRE.

Part III of this serial will appear in the next Number—Eds.

PROCEEDINGS.

BOMBAY NATURAL HISTORY SOCIETY.

A meeting of Members of the Bombay Natural History Society and their friends was held at the Prince of Wales' Museum on Wednesday, the 22nd August, at 6-15 p.m. Mr. J. G. Ridland presided.

The Honorary Secretary, Mr. H. M. McGusty, announced the election of 46 members since the last meeting held on 19th March 1934.

Mr. T. Sinclair-Kennedy, Bombay; Mr. Harold N. Sidney, Bombay; Dr. Ram Narain Sewal, Pauri; The Honorary Secretary, E.I. Rly. European Institute, Dhanbad; Capt. H. P. E. Waters, Bombay; Mr. R. E. Parsons, Assam; Capt. W. T. Dixie, I.A.S.C., Karachi; Mr. L. G. D. Wakely, Karachi; Mr. Donald G. Hill, F.R.G.S., Bombay; Mr. W. A. Hewitt, Samastipur; Major-General S. B. Pope, C.B., D.S.O., Poona; Mr. A. E. Hubbard, Asansol; Capt. J. Lindsay Smith, Quetta; The Principal, Pittapur Rajah's College, Cocanada; Mr. R. A. Dyson, Bombay; Mr. M. J. Hackney, Bombay; Mr. M. C. Jacob, I.F.S., Gauhati; Mr. H. A. Keatinge, Kurseong; Mr. A. F. W. Humphrys, Karachi; Mr. E. Raghavendra Rao, Nagpur; Mr. V. S. Rao, I.F.S., Jalpaiguri; Mr. R. B. Carrick, Madras; Capt. C. Harford, Simla; The Librarian, J. N. Petit Institute, Bombay; Mr. H. V. Blackburn, Manipur; H. H. The Maharaja of Orchha, Tikamgarh; The Raja of Jaunpur, Jaunpur; Mr. H. E. W. Braund, Rangoon; The Principal, Lawrence Memorial Royal Military School, Lovedale; The Raja and Ruling Chief of the Feudatory State of Ranpur State; Ranpur; Mr. G. B. Baksi, I.F.S., Bhandara; H. H. The Raja Saheb of Nilgiri State, Raj-Nilgiri; Mr. E. S. Lewis, M.B.E., I.C.S., Lyallpur; The Inspector-General of Forests, H.E.H. the Nizam's Dominions, Hyderabad; H. H. the Maharajadhiraj of Sirohi, Sirohi; Mr. L. G. Redmond, M.I.C.E., Bombay; Mr. C. J. West, Bombay; Mr. D. Davis, Bombay; Mr. A. L. Terry, Bombay; The Director of State Gardens, Gwalior; The Raja Saheb of Bhinga Raj, Bhinga; Mr. S. A. Vahid, I.F.S., Khandwa; The Raja of Baudh State, Baudhraj; Col. A. M. Leake, V.C., V.D., Calcutta; Major D. M. Fraser, I.M.S., Cawnpore; Capt. Sardar Bhimrao Nagojirao Patankar, Satara.

Mr. Stanley Jepson then delivered his lecture on 'Wild Animals and their Ways'.

The lecturer dealt with some fascinating features of the animal mind and disputed problems. Speaking of the oft-mooted point whether wild animals possess a sixth sense which enables their subconscious mind to register the evil intentions of poachers, sportsmen or even of the carnivora, Mr. Jepson said many people had enlarged on the theory including Col. A. T. R. Glasfurd, who, in his last book had devoted several pages to it. After a lifetime of shikar Col. Glasfurd was convinced that certain animals did possess this mysterious sense.

'He must have known I had a rifle', was a remark often heard when sportsmen related their experiences of animals who remained still until the last minute following careful stalking and then cleared off. Mr. F. W. Champion in his last book had stated that he found the same problem in stalking animals to photograph them. It was always when he was about to take a picture that the animal fled. M. Jepson thought that the explanation was that the animal mind merely feared the attentions of humanity, good or evil, in the same way that a child resented being made a fuss of by a stranger. It was the fear of the unknown.

Curiosity in animals, especially the deer, often led to their losing their lives to carnivora or hunters. This the lecturer said, was more marked in the female.

Dealing with the larger carnivora the lecturer produced a panther cub and said observation of its habits showed how potent a factor instinct was in animal movements. Even though kept as a pet since it was a week old, the cub could not walk straight across a room but had to stalk under chairs and slink about. It carried things backwards in the same way as a large tiger dragged a carcase. Speaking about the disputed point whether panthers had scent, Mr. Jepson said his experiments with the cub showed that it had no scent.

In conclusion, Mr. Jepson made a plea for legislative action towards the conservation of India's very rich and varied fauna. The causes of the present marked diminution of wild life, he said, were the production of cheap rifles, the commercialised value and marketing of things like venison, hides and horns, the growth of poaching partly due to the large number of 'crop protection rifles', which were often used for supplying villagers with meat, the inevitable spread of cultivation of erstwhile forest areas and the lowered ethics of present-day shikar, shooting from motor cars.

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AND C. McCANN, F.L.S.

VOL. XXXVII, No. 4.

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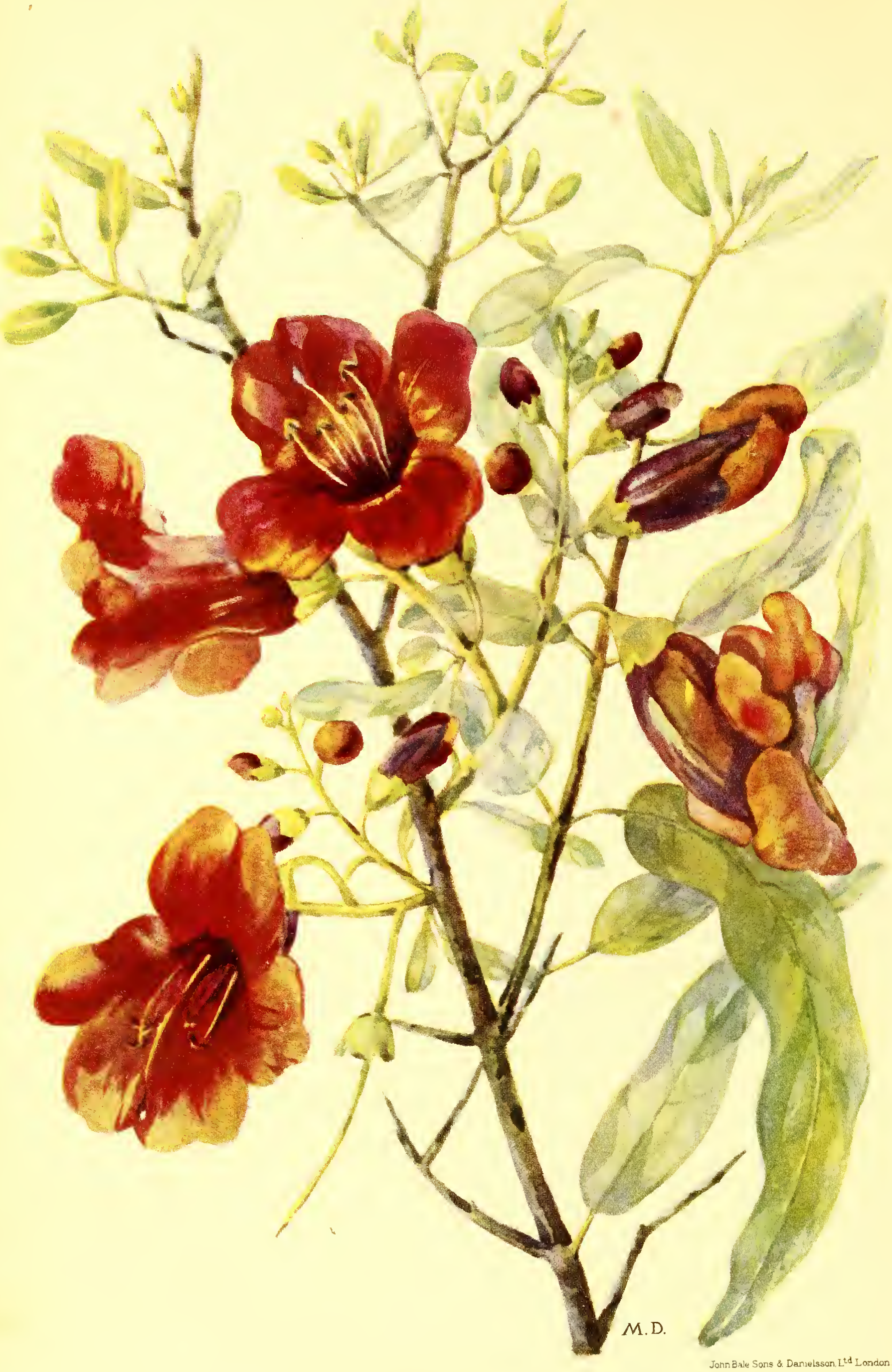

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WAVY-LEAFED TECOMELLA.
Tecomella undulata, Seem.
(about 2/3 nat. size)

JOURNAL
OF THE
Bombay Natural History Society.

April, 1935. Vol. XXXVII. No. 4.

SOME BEAUTIFUL INDIAN TREES.

BY

The late E. Blatter, s.j., ph.d., f.l.s.,
and W. S. Millard, f.z.s.

Part XVII.

(*With one coloured and one black-and-white plates*).

(*Continued from page 514 of this volume*).

Plate XXV.—Wavy-leafed Tecomella.

Popular names: Rori (Bal.); Lohero (Sind); Lahura (Punjab); Roheri, Roira (Merwara).

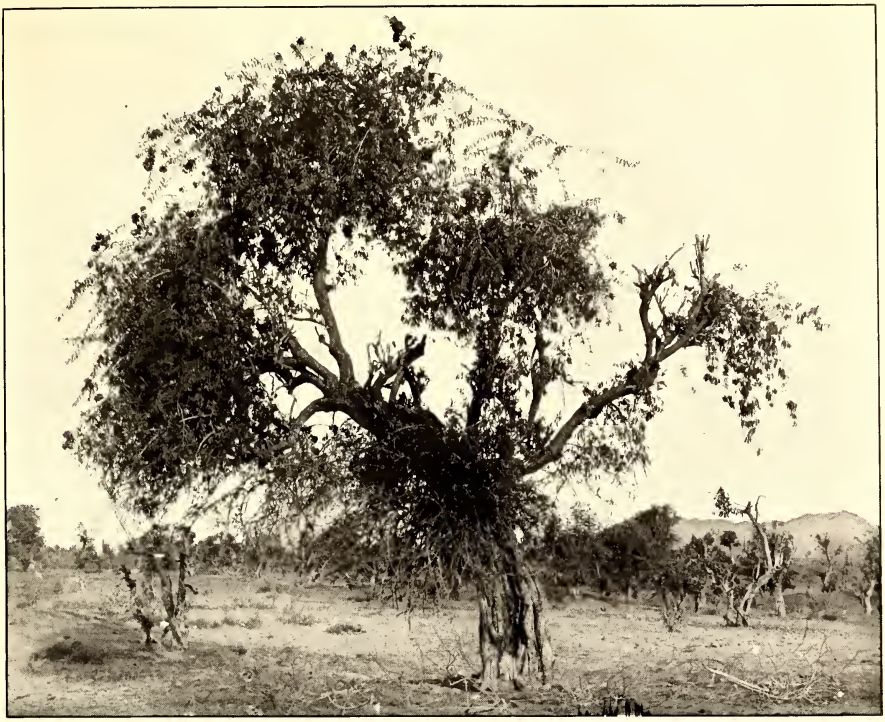
Tecomella undulata Seem. in Ann. & Mag. Nat. Hist., ser. 3, vol. 10 (1862), p. 30. *Tecoma undulata* G. Don, Gen. Syst. V. H. (1837), p. 223.—Belongs to the family *Bignoniaceae*. *Tecomella* is derived from the generic name *Tecoma* itself derived from the Mexican name of a plant: *Tecomaxochitl* (*tecomatl* = vessel + *xochitl* = flower).

Description: A large shrub or small tree with drooping branches and greyish green foliage. Leaves 2-5 by $\frac{3}{8}$-$1\frac{1}{4}$ in. narrowly oblong, blunt at the apex and with wavy margins, covered with minute hairs and slightly rough; leaf stalk 1 in. long. Flowers large, from pale yellow to deep orange; inodorous, in smaller or larger 5-10 flowered bunches at the ends of the smaller lateral branches; stalks $\frac{1}{4}$-$\frac{1}{2}$ in. long, cup-shaped with 5 almost equally rounded lobes, veined. Stamens 4, filaments smooth. Stigma divided into two lobes. Fruit 8 in. long by $\frac{3}{8}$ in. broad, slightly curved, parallel sided, smooth and sharply pointed at the tip. Seed winged 1 by $\frac{3}{8}$ in. (including the wing), wing thin, very narrow, rounded at the top and absent at the base of the seed.

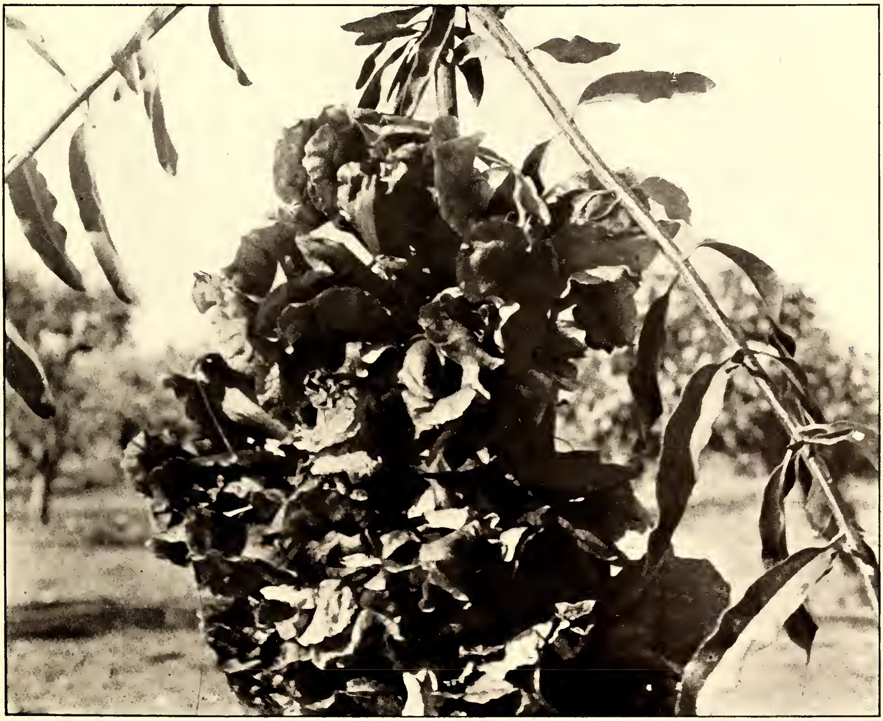
Distribution: India, Western Peninsula, Punjab, Rajputana, Baluchistan; Arabia.

Gardening: A very handsome tree when in full bloom and really worthy of cultivation. It is easily propagated from seed or cuttings (Troup). It is not uncommon in the drier tracts of India, flowering between February and April.

Uses: The bark is employed in Sind as a remedy for syphilis. The leaves are eaten by cattle. The wood is strong, tough and durable; takes a fine polish, and is highly prized for furniture (Watt. Dict. Econ. Prod.). The wood is yellowish brown, mottled, handsome, highly-prized for furniture, carving and agricultural implements (Brandis). It is drought-hardy and very resistent to fire. It would be a useful species for afforesting dry tracts (Troup).



Wavy-leafed Tecomella (*Tecomella undulata* Seem.) Tree in flower, Maval, Rajputana.



Flowers of the Wavy-leafed Tecomella (*Tecomella undulata* Seem.)

Photos by C. McCann.

THE VERNAY SCIENTIFIC SURVEY OF THE EASTERN GHATS.

(Ornithological Section).

BY

Hugh Whistler, m.b.o.u., assisted by N. B. Kinnear, m.b.o.u

Part X.

(Continued from page 528 of this volume).

[**Psittacula eupatria** Linnaeus.

Psittacus eupatria Linnaeus, Syst. Nat., ed. xii (1766), p. 140—Gingee.

The Large Parakeet is said to occur in the Presidency, but the fact never appears to have been properly verified. Jerdon says that it is found in the forests of Malabar, in the Northern Circars and occasionally in parts of the Carnatic. Stewart is said to have found it in Travancore though none of the other observers in that State record it.

In the *New Fauna* (vol. vii, p. 339) the type locality is given as Ceylon. It should, however, be Gingee as Linnaeus based his description on the *Psittaca ginginiana* of Brisson (Aves, iv, p. 343).

The arrangement of the races of this species in the *New Fauna* does not appear to me to be satisfactory. Birds from Sikkim and the Duars are attributed to the race *indoburmanica*, as are also birds from Burma generally. I have examined a good series of these Parakeets from the Sikkim-Duars area and cannot find that they differ in any particular from *Psittacula e. nepalensis* (Nepal, Punjab, United Provinces). Burmese birds on the other hand are definitely distinguishable from *nepalensis*. They lack the bluish wash on the sides of the head and nape and the mandibular stripe is most markedly narrower; whilst their larger size and narrower mandibular stripe equally separates them from the typical race. The difference between the Sikkim-Duars and Burmese birds was recognised by Hume in naming his *Palaeornis indoburmanicus* (S.F., vii, p. 459) but he expressly stated that further subdivision was unnecessary. How he came to consider the Sikkim-Duars birds separable from *nepalensis* is not clear to me. Accepting their identity there is no doubt that the name *indoburmanieus* must become a synonym for *nepalensis*. Reading the original description one has no difficulty in seeing that Hume primarily intended to apply it to the Sikkim bird with which he contrasts Burmese birds. This was recognised by Kloss [J.N.H.S. (Siam), vol. ii (1917), p. 219] who made the point clearer by restricting the type locality to Sikkim. He then proceeded to name Burmese birds *Palaeornis eupatria avensis* (type locality Bhamo) and this name will stand for them.]

Psittacula krameri manillensis (Bechstein).

Palæornis manillensis Bechst., Stubenvögel (1794), p. 612—Africa and the Philippines *errore*—Ceylon.

Specimens collected:—518 ♂ 5-7-29 Kalai, Trichinopoly; 940-941 ♂ ♀ 30-10-29 Nallamallai range 2,000 ft.; 1129 ♂ 17-12-29 Cumbum Valley.

Measurements:—

	Bill from cere.	Wing.	Tail.	Tarsus.
3 ♂	22.5-23	171-172	243.5	16-17 mm.
1 ♀	22	155.5	185.5	17 mm.

There is curiously little information on record about the Green Parakeet in the Presidency though one suspects it to be common and generally spread.

On the eastern side I have found no actual records of it except the above Survey specimens and Dewar's statement that it is common at Madras in the cold weather but less frequently seen in the hot weather. On the western side it is only actually recorded in the Palnis and Travancore. Of the Palnis Fairbank said that it is common round the base, sometimes ascending the hillsides. Terry found it on the slopes below Pulungi and in the Pittur Valley. In Travancore according to Ferguson it is very common throughout the low country, breeding in February and March.

It is curious that everyone appears to have overlooked the variation in size from north to south of this common species. Four males from the type locality Ceylon measure: bill (from cere) 22·5-23·5 mm., wing 156·5-165 mm., tail 197-225 mm. and I have no hesitation in keeping with the typical form the few specimens available from Travancore, Mysore and the Madras Presidency up to the Cumbum Valley. Eleven males from this area, including the above Survey and Ceylon specimens, yield a range of bill (from cere) 22-24 mm., wing 156·5-172, tail 197-243·5 mm. Ten males from the Punjab, on the other hand, measure: bill (from cere) 23·5-26·5 mm., wing 175-186·5 (once 190·5) mm., tail (once 189) 225-263 mm. This marked difference cannot be overlooked even though the advance in size throughout the Peninsula is gradual as in other species. There is no sharply defined boundary between the races, therefore, but for convenience it may be fixed arbitrarily at the 20° latitude. Northern birds also average very slightly paler and yellower in colour. On the other hand I am unable to agree with the separation of Assamese from North Indian birds on the colour of the lower mandible. This is a feature which is rather hard to assess as roughly 50 per cent of specimens throughout India and Assam have the lower mandible parti-coloured so that one is at a loss whether to consider it black or red. Examination of a number of specimens however gives the following figures:—

Locality.	Lower mandible red.	Intermediate.	Lower mandible black.
Punjab, Sind	6	6	2
Assam	9	8	2
S. India & Ceylon	—	6	8

These figures show clearly that, while the black lower mandible is of service as a racial distinction in the smaller southern race, it is no distinction as between the larger northern birds and birds from Assam. They are alike in colour and size, unless Assamese birds average slightly more blue in tint. The difference, if it exists, is not however marked enough to warrant racial separation.

Psittacula krameri borealis Neumann, Orn. Monatsb., vol. xxii (1915), p. 178—Assam, should therefore include the large North Indian birds.

Psittacula cyanocephala cyanocephala (Linnaeus).

Psittacus cyanocephalus Linnaeus, Syst. Nat., i (1766), p. 141—India Orientale, now restricted to Gingee, S. Arcot.

Specimens collected:—4 ♂ 9-4-29 Kurumbapatti; 783 ♂ 1-9-29 Kodur; 1553 ♂ 16-3-30 Sankrametta 3,000 ft.

Measurements:—

	Bill from cere.	Wing.	Tail.	Tarsus.
3 ♂	16-18	133-138	177-222	11-13 mm.

The Blossom-headed Parakeet is probably very generally spread in the Presidency as a resident species. On the eastern side it is common in the Northern Circars and the Carnatic according to Jerdon and in addition to the three Survey localities we know that it occurs at Madras, where Dewar states it is not so common as the Common Green Parakeet.

On the West it is extremely common in Coorg (Betts). William Davison says that it is not uncommon in the Wynaad and at the base of the hills, ascending the Nilgiris to about 3,500 ft. I have seen specimens from Cannanore (♂ 9-10-82 Wardlaw-Ramsay), Calicut (♂ 9-3-83 Wardlaw-Ramsay) and Malappuram (♂ 2-7-12 Sparrow Collection).

On the Palnis it is common at Pulungi and other localities on the slopes up to 4,000 ft. In Travancore, Ferguson says that it is common in the low country, wherever there is forest and also about the foot of the hills, which however it does not ascend.

Betts says that the nesting season begins in Coorg at the beginning of January and Ferguson gives March for Travancore.

As in the case of the last species this Parakeet must be divided into a northern and southern race in the Peninsula on the question of size, though there is of course the usual intergrading between them. Twenty males from Ceylon, Travancore, Kurumbapatti, Wynaad and the Nilgiris measure:—wings 131-143 mm., tail 171-222 mm. Seventeen males from Northern India (Punjab, United Provinces, Orissa, Bengal) measure:—wings 137·5-151·5 mm., tail 172-234 mm. As names already exist applicable to these areas the two races may be recognised and the boundary between them may be taken as the 20th degree of latitude.

Only two races are recognised in the *New Fauna*, the Eastern and the Western—the latter including our North Indian and South Indian—both of which were considered as species in the *Old Fauna.* Considerable dispute has from time to time taken place over the correct names for these birds and it is desirable to settle the question. The evidence to go upon is not very good but nevertheless sufficient we think to prove our case.

The differences between the Eastern and Western birds are in the colour of the head—a difference not very easily shown in a coloured plate—and in the colour of the under wing-coverts. This last cannot of course be seen in a picture and it is not mentioned in any of the descriptions.

To begin with the oldest name is *Psittacus cyanocephalus* Linnaeus, Syst. Nat., i, p. 141, 1766, based on the description and uncoloured plate in Brisson's *La Perruche à tête Bleue* (Ornithologie, iv, p. 359, pl. xix, fig. 2, 1760). This bird was a female in the collection of Abbé Aubray and was said to have come from Inde Orientale—a vague term in those days for anywhere east of Suez. This Abbé Aubray apparently had a considerable collection, from all parts of the world, since Brisson frequently refers to it in his volumes, but after a search we can only discover two species which are definitely said to have come from India. These are *La Perruche à tête rouge de Gingi* (vol. iv, p. 346, pl. xxix, fig. 2) and *La Perruche de Gingi* (vol. iv, p. 343, pl. xxix, fig. 1). The first is a synonym of *Psittacus cyanocephalus*—a male—and the second the origin of *Psittacus eupatria* Linnaeus. Since both the birds came from Gingi we may fairly well assume that *La Perruche à tête Bleue* also came from the same locality and the name *cyanocephalus* will stand for the South Indian race. For the North Indian bird *Psittacus bengalensis* Forster Indische Zoologie, 1781, p. 40, is available and is founded on Brisson's plate and description (Ornithologie, iv, p. 348, 1781) of *La Perruche de Bengale.* But Brisson never saw the bird himself and copied his description from Edward's plate and description of the Rose-headed Ring Parakeet (History of Birds, vol. v, p. 47, pl. 233) and Albin, History of Birds, vol. iii, p. 14, pl. 14, of a bird sent home from Bengal—almost certainly Calcutta[1]—to which place the type locality may be restricted. To the Eastern race we may restrict the name *rosea* of Boddaert, Table Pl. Enlum., p. 53, 1783, which was given to the plate and description of the *Perruche de Mahé* in Daubenton's Planche Enl., vol. vii, pl. 41.

In the letterpress Daubenton makes no mention of any locality but says his bird is similar to Edward's Rose-headed Ring Parakeet. On the plate however it is given as *de Mahé.*

The colour of the head of the bird on this plate is too light for any Blossom-headed Parakeet from Western India and probably came from somewhere east of Calcutta; we restrict the type locality to Chittagong.

Psittacula columboides (Vigors).

Palaeornis columboides Vigors, Zool. Jour., vol. v, pt. xviii (June 1830), p. 274, no locality—restricted to Aneichardi, Travancore.[2]

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[1] We are very grateful to Dr. Baini Prashad, Director of the Indian Museum, for specially procuring us topotypes of this Parakeet from the neighbourhood of Calcutta to enable us to verify the correctness of this restriction.

[2] Stuart Baker, *J.B.N.H.S.*, xxviii, p. 160.

Not met by the Survey, as in the Presidency it is confined to the western side. Betts reports that it is common in Coorg. William Davison states that it occurs throughout the Wynaad and the Nilgiris. It is perhaps most numerous on the slopes up to about 5,000 ft. but occasionally ascends to the plateau and the good series in the British Museum contains specimens from Ootacamund.

According to Kinloch, this is the only species of Parakeet in the Nelliampathies. Fairbank found it common on the Lower Palnis and along the hillsides and Terry records it from the slopes below Pulungi.

In Travancore it is confined to the hills, not ascending about 3,000 ft. in the south but found at 5,000 ft. in the High Range.

According to Betts, the breeding season of the Blue-winged Parakeet starts in Coorg in January. In Travancore, Bourdillon considered the breeding season to last from 1st January to the end of March and most eggs appear to have been taken in January and February (see Hume's Nests & Eggs, vol. iii, p. 89 and Stuart Baker, *Nidification,* vol. iii, p. 381).

This beautiful bird occurs along the Western Ghats as far north as Khandala. In its limited range it exhibits the slight increase in size from South to North common to many species with a similar distribution, but the increase is too slight and the range too limited for any useful purpose to be served by an attempt to recognise two subspecies.

Coryllis vernalis rubropygius Stuart Baker.

Coryllis vernalis rubropygius Stuart Baker, Bull. B.O.C., vol. xlvii (1926), p. 44—Belgaum.

Specimens collected:—1329 ♂ 6-3-1930, 1777 ♂ 5-5-1930 Anantagiri 3,000 ft.

Measurements:—

	Bill from cere.	Wing.	Tail.	Tarsus.
2 ♂	12-12·5	92-96·5	42-42·5	10-10·5 mm.

The Survey found the Indian Lorikeet common at Anantagiri when the Silk-Cotton tree was in bloom, and Mr. La Personne considered that it was probably breeding in April. He also found it at Sankrametta at 3,000 ft., but there it was not common.

This is another of the interesting discoveries made by the Survey as hitherto this species was not known to occur anywhere between the Himalayas and Assam and South-West India. In the latter area it is of course common and well-known.

In Coorg it is very common (Betts). William Davison found it generally distributed throughout the Wynaad and remarks that in some parts, especially along the old avenues of Jack trees about Manantoddy, it was quite common. It ascends the slopes of the Nilgiris to about 6,000 ft. Jerdon remarks how intoxicated birds were taken at Tellicherry, this little bird often imbibing too freely from the juice of the Toddy tree.

Kinloch considered the Lorikeet common in the Nelliampathies. Fairbank noted it several times at the eastern base of the Palnis and Terry met several in the Pittur Valley. In Travancore, Ferguson says that it is common on the hills and he describes a nest with 3 hard-set eggs found at 2,000 ft. by Bourdillon. This was on 15 March, and another with 3 eggs was found by Stewart on 6 January (Stuart Baker, *Nidification*, iii, 386).

It is with considerable hesitation that I have kept up the race *rubropygius*, which, if separable, differs from the typical race solely in the duller more saturated red of the rump patch as compared with the vivid red of this patch in Assamese birds.[1] In my experience this distinction only holds good for a limited number of specimens, and I am not sure how much it depends on individual variation, wear or age. The two Anantagiri specimens, for instance, vary greatly in the colour of their rumps, one agreeing with the northern, the other with the southern race, and it is probable that a larger series would merit inclusion in the typical race. I am also very doubtful as to the correctness of the present grouping of these small Lorikeets into species and subspecies and suspect that ultimately *vernalis* will prove to be a race of *Coryllis beryllinus* of Ceylon. A decision of this point should however only be made after a full study of the whole group to ascertain the respective extent of its specific and subspecific characters.

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[1] In vol. vii, p. 343 of the *New Fauna*, Stuart Baker has omitted his restriction of the type locality to Cachar (J.B.N.H.S., xxviii, 161).

Coracias benghalensis indica Linnaeus.

Coracias indica Linnaeus, Syst. Nat., ed. xii, vol. i (1766), p. 159—Ceylon.

Specimens collected:—373 ♂ 9-6-29, 388 ♂ juv. 12-6-29, 405 ♂ 14-6-29 Chitteri range 2,000-3,000 ft.; 532 ♀ 7-7-29 Kalai; 602 ♀ 24-5-29 Gingee; 1152 ♀ 21-12-29, 1179 ♀ 27-12-29 Cumbum Valley.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
2 ♂	40-42	174-184·5	120-123	25-26 mm.
4 ♀	40-42·5	177-186	119-125	25-26 mm.

As in the case of many other common and doubtless generally distributed species, I am unable to find any actual record of the Indian Roller or Blue-Jay in the Presidency north of the River Godavery. Southwards it occurs in some numbers though not apparently quite so numerously as in Northern India. La Personne found it plentiful and breeding everywhere in June in the Chitteri Range at 3,000 ft., occurring also in the Shevaroys up to 4,000 ft.

On the West it is much less common. In Coorg, Betts says that it is an occasional visitor in the dry season, never staying very long. While it occurs in the Wynaad and about the base of the Nilgiris it is not abundant and does not ascend the latter. In the Palnis, it seems to be confined mostly to the eastern base and Terry records it in the Pittur Valley. In Travancore also it is said by Ferguson to be confined to the low country, being common only towards Cape Comorin. Elwes however met it in the Cardamum Hills (*Ibis* 1870, p. 526).

Nothing is recorded about the breeding season in the Presidency.

In the *New Fauna* (iv, pp. 224-226) Stuart Baker confines this race of the Blue-Jay to Ceylon and South Travancore, stating that it differs from the typical race both in size and colour. The difference in colour I am not, however, able to confirm, and as regards size I find that the Blue-Jay agrees with so many other species in showing a gradual increase in size from south to north. The available series from Ceylon is a poor one, seven specimens in the British Museum and these not all sexed. They measure:—bill 37-47 mm., wing 171-184 mm., tail 116-128 mm. Fourteen birds from the Presidency, including the Survey series, and Bangalore measure:—bill 39-49 mm., wing 171.5-186 mm., tail 109-125 mm. These are clearly not separable from the Ceylon series and birds from Hyderabad, Kanara, Belgaum and Ahmednagar are certainly nearer to these than to the large northern race of which I measure a series of thirteen specimens (Punjab):—bill 42-49 mm., wing 183.5-201 mm., tail 128.5-139.5 mm. The line of division between the two races must necessarily be arbitrary and it may most conveniently be fixed along the 20th degree of latitude.

Eurystomus orientalis (Linnaeus).

Coracias orientalis Linnaeus, Syst. Nat., ed. xii (1766), vol. i, p. 159—India.

The Broad-billed Roller is not known to occur on the eastern side of the Presidency and it was not observed by the Survey. On the West it appears to be fairly general but scarce. William Davison says that he once met with it in the Wynaad. Vipan (S.F., i, 495) says that he saw several in August 1872 in the Malabar jungles near the foot of the Carcoor Ghat of the Nilgiris, and this was apparently at Nellumbore where R. W. Morgan also obtained several specimens and procured the eggs (S.F., ii, 532). William Davison says that he had sometimes seen it on the Coonoor Ghat.

Kinloch found it breeding in the Nelliampathies, a pair with young in March.

In Travancore it seems to be better known, though there is some doubt about its actual status. F. W. Bourdillon (S.F., iv, 382) says: 'This bird, nowhere abundant, is, I think, only a visitor, although I have observed it in August, during the winter months, in April and as late as May'. This is amplified by T. F. Bourdillon (N. & E., iii, 58):—'They come to us about the beginning of August and leave towards the end of April, after breeding. They are not very common but almost every estate has its pair which generally are to be found at about 1,000-2,000 ft. above sea-level. This he again expands (J.B.N.H.S., xv, 658):—'Comes to us to breed, leaving Travancore again before the commencement of the monsoon. Pairs of these birds may be seen here and there throughout the length of the hills at elevations from 500-3,000 ft., any time between September and the end of April; but they are by no means common.' Ferguson says that it is eminently a forest species but he only procured a single specimen. I find it hard to believe that the bird is not a resident.

F. W. Bourdillon took 3 eggs on the 17th March. T. F. Bourdillon found an occupied nest on 20th April and in *Nidification* (iii, 392) Stuart Baker gives the breeding season in Travancore variously as September to May and March to May on the authority of the Bourdillons.

Sharpe described these South-West Indian Rollers as a separate form *Eurystomus lætior* P.Z.S. 1890 (October), p. 551—Malabar, but the *New Fauna* attributes them to the typical race. I have seen too poor a series of Indian specimens to decide between these conflicting opinions.

Merops orientalis orientalis Latham.

Merops orientalis Latham, Suppl., Index Orn. (1801), p. xxxiii—Mahratta, India.

Specimens collected:—173 ♀ 2-5-29 Kurumbapatti; 292-3 ♂ juv., ♀ 30-5-29, 421 ♂ 15-6-29 Chitteri Range 2,000-3,000 ft.; 515-6 ♂ ♀ 5-7-29 Kalai; 664 sex? 8-8-29 Palkonda Hills 1,000 ft.; 781 ♂ 1-9-29, 785 ♂ 2-9-29 Kodur 500 ft.; 912 ♀ 13-10-29 Seschachalam Hills 2,000 ft.; 1035 ♀ 25-11-29 Nallamallai Range 2,500 ft.; 1058-60 ♂ ♂ ♂ 8-12-29 Cumbum Valley.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
7 ♂	31-33	92-98·5	119-129·5	9-10 mm.
5 ♀	31-33·5	92-94	109-126·5	8-10 mm.

The Little Green Bee-eater does not appear to have been actually recorded in the northern part of the Presidency down to the Godavery, but it doubtless occurs in this area as plentifully as elsewhere. Southwards it appears to be very generally and plentifully distributed presumably as a more or less resident bird though it is true that Dewar seems to have some doubt whether it bred about Madras City or not (J.B.N.H.S., xv, 492; xvii, 522).

On the West, Ferguson considered it one of the commonest birds in the low country in Travancore. Fairbank found it plentiful at the base of the Palnis and in the adjacent plains, Terry mentioning it in the Pittur Valley. William Davison tells us that it is common on the slopes of the Nilgiris up to 5,500 ft., occurring also up to 6,000 ft.; it is also common about the foot of the hills and in the Wynaad. Here it seems to be a resident, breeding in the Nilgiris in March and April. In Coorg, on the other hand, Betts (J.B.N.H.S., xxxiii, 548) says that it is exceedingly common as a winter visitor, arriving in October (10 October, 1928) and leaving at the beginning of March (7 March, 1929). In 1932 he first saw it on September 12 (J.B.N.H.S., xxxvii, 225). This corresponds well with Taylor's experience at Manzeerabad, Mysore (S.F., x, 456) that the birds arrived in the middle of September, leaving again in June, with John Davidson's experience in Kanara that it was absent in the rains (J.B.N.H.S., xii, 43), and Benjamin Aitken's account (N. & E., 2nd ed., iii, 61) that it leaves Bombay from April to September.

Merops orientalis orientalis occupies the rather unsatisfactory position of an intermediate race between the pale, clear-coloured green of *M. o. biludschicus* with little golden sheen on the crown and the more opaque green of *M. o. birmanus* which has a very definite ferruginous-golden sheen on the crown and hind part. These two extreme races when contrasted with each other are very distinct, and *orientalis* and *birmanus* are as a rule sufficiently recognisable *inter se*. The difference between *biludschicus* and *orientalis* on the other hand is poorly defined and can only be recognised on series of which the locality is known. The blue on the throat is a variable feature of no racial significance in the three Indo-Burmese races. The few Travancore specimens that I have seen approximate, as might be expected, towards the richer colour of *birmanus* but it is unnecessary to do more than note the point, as *orientalis orientalis* varies a good deal in depth of colouration throughout its whole range.

Merops superciliosus javanicus Horsfield.

Merops javanicus Horsf., Trans. Linn. Soc., vol. xiii, pt. i (May 1821), p. 171—Java.

Specimens collected:—1142 ♂ 19-12-29, 1143 ♂ 21-12-29 Cumbum Valley.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
2 ♂	45	133-138	139·5-141	11-13 mm.

The Blue-tailed Bee-eater appears to be widely distributed in the Presidency. Ball met it at Jeypore in April (S.F., v, 413). Colonel Sparrow obtained a specimen, now in his collection, at the Kolair Lake on February 1st. The Survey obtained two specimens in December in the Cumbum Valley. In the neighbourhood of Madras, according to Dewar, it is very common in the paddy fields in the cold weather. Jerdon tells us—with his usual irritating indifference to dates—that on one occasion he saw an immense flock, probably many thousands at Caroor (Karur) on the road from Trichinopoly to the Nilgiris.

On the western side a specimen from Calicut (♂ 4-4-83 Wardlaw-Ramsay) is in the British Museum. William Davison says that these Bee-eaters are very locally distributed and not numerous, always in small flocks which never stay more than a few days in any one locality. He goes on to say that he has seen them on the Coonoor Ghat, on the skirts of the Government Cinchona Plantations at Neddivattum, and in the Wynaad at the foot of the Brahmagherries. In the Nelliampathies, according to Kinloch, they are very common on the Northern slopes.

In the Palnis in October 1866 Fairbank found the Blue-tailed Bee-eater abundant by the town of Palni, near the north base of the hills. On his later visit he only observed it once, near Perinr.

In Travancore Ferguson only knew of one specimen, shot near Trivandrum in August 1893.

Rhodes Morgan (*Ibis* 1870, p. 314) says that this species breeds in large numbers in the banks of the Kistna and Cauvery Rivers. I do not know if this record is reliable and there is no other record of the breeding of this Bee-eater in the Presidency. It is a winter visitor to Ceylon and its movements in most localities are difficult to understand so I will not attempt to define its status.

To prevent further confusion I may note that the young Bee-eater obtained at Pundharpur in October (S.F., vii, 77) was *persicus*. In the *New Fauna*, vol. iv, p. 233, it masquerades as *apiaster* while in the *Journal, Bombay Natural History Society*, xxxvii, it has become *javanicus*.

Merops leschenaulti leschenaulti Vieillot.[1]

Merops leschenaulti Vieillot, Nouv. Dict., vol. xiv (1817), p. 17—Ceylon.

No specimen of the Chestnut-headed Bee-eater was obtained by the Survey but La Personne states that a single specimen was seen at Kurumbapatti after a heavy shower of rain. He considered it had probably come down from the Shevaroys from which hills there is a specimen in the Madras Museum. No one else has recorded it on this side of the Presidency except Rhodes

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[1] For genus see Ticehurst, *J.B.N.H.S.*, xxxiv, 471 and xxxvi, 934.

Morgan who states that it breeds in large numbers on the banks of the Kistna and the Cauvery (*Ibis* 1870, p. 314).

On the western side it is far better known though its movements seem rather erratic and difficult to understand. In Coorg Mr. Betts considered it a passage migrant as it was extremely common in large flocks in June 1928. It disappeared entirely at the end of the month and was not again observed save for a flock on September 24th. It is not uncommon in the Wynaad.

In the Nilgiris it is common up to about 4,500 ft. and occurs certainly up to 5,500 ft. though it does not ascend to the plateau. Here it breeds in March and April (W. Davison) and Mr. Betts informs me that it leaves the western side (at any rate) of the hills in June, returning about November.

In the Nelliampathies it is common on the northern slopes (Kinloch). In the Palnis Fairbank found it common on the eastern side of the hills at 2,000-3,000 ft. on his first visit in 1866 but on a subsequent trip only saw it once. Terry saw several in the Pittur Valley.

In Travancore, Ferguson says it is confined to the hills where it is not uncommon in North Travancore about Pirmerd and the High Range. Here he says it breeds in February.

All Indian specimens are quite inseparable in colour from Ceylon birds. The few Ceylon specimens that I have seen, however, appear to have shorter bills than Peninsula specimens; but a proper series may prove that this is incorrect.

The name of this bird has long been a cause of dispute amongst ornithologists. Many years ago both Hume and Lord Tweeddale pointed out that *Merops erythrocephalus* Gmelin, Syst. Nat., i, p. 433 (1778), based on Leguépier à tête rouge des Indes of Brisson Aves, vol. iv, p. 563, pl. 44, fig. 3 (1760) could not be used. Unfortunately however in 1919 Stuart Baker, Jour., Siam Nat. Hist. Soc., vol. iii, p. 432, saw fit to revert to its use, since he said Brisson's description and figure were quite recognisable. Brisson's figure was uncoloured, but Shaw and Nodder, Nat. Misc., pl. 357 (1778), gave an exact copy which they coloured from the description. Neither in this coloured plate nor in Brisson's description is there any sign or mention of the black line across the breast, nor the turquoise blue of the rump. From the position the bird is drawn in this last colour should be very evident. Shaw's figure shows a bird with a chestnut head, green back, tail and wings and yellowish-white below and does not represent, as far as we know, the colour of any known Bee-eater.

The next name which must be considered is *Merops leschenaulti* Vieillot, Nouv. Dict., vol. xiv, p. 17, 1817, based on Le Vaillant's *Le guêpier laichenot*, pl. 18, p. 55 in Hist. Nat. Des Promerops (1806). The figure and description agree except in one particular viz., the throat which is described as follows: 'La gorge est couverte d'une plaque triangulaire, d'un roux jaunâtre, laquelle se termine par un collier étroit gris-vert, qui, dans l'ombre, semble noirâtre', whereas in the plate it is pale yellow. The figure is that of a young bird of the Ceylon-Indo-Malayan race, with some greenish feathers on the head, black line passing from the base of the bill to several millimetres beyond the eye, and a not very distinct black line across the throat. The green feathers on the crown and the indistinct breast line are both signs of immaturity.

The bird is said to come from Java but it certainly never did, and there is in the British Museum Collection a young specimen from Assam which agrees with the picture very closely.

The name therefore for the typical race will have to be *Merops leschenaulti leschenaulti* Vieillot, Nouv. Dict., vol. xiv, p. 18, 1817, and the type locality Ceylon.

For the Javan race the name *Merops quinticolor* Vieillot, Nouv. Dict., vol. xiv, p. 21, 1817, is available. The description is taken from Le Vaillant's *Le guêpier quinticolor* Hist. Nat. Des Promerops, pl. 51, p. 15, 1906, which is said to come from Ceylon. The figure and description however are clearly that of a bird with a narrow black band across the breast, the black line not passing beyond the eye, the characters of the Javan race. Exception may be taken to the blue feathers in the wing-coverts of the figure, but these are not uncommonly seen in this species and probably may be accounted for by the fact that the feathers are worn. This race will therefore stand as *Merops leschenaulti quinticolor* Vieillot, Nouv. Dict., vol. xiv, p. 21, 1817. Type locality Java.

From the descriptions and figures it appears quite evident that Le Vaillant had mixed his localities as Oates many years ago pointed out in Birds of Burma, vol. ii, p. 68, 1883.

Alcemerops athertoni (Jardine & Selby).

Merops athertoni Jardine & Selby, Illustr. Orn., vol. ii (1828), pl. 58—India; Bangalore (see Ibis 1925, p. 751).

Specimens collected:—290 ♀ 30-5-29, 299 ♀ 31-5-29 Chitteri Range 2,000 ft.; 1416-17 ♂ ♀ 20-2-30, 1441 ♀ 25-2-30 Anantagiri 3,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
1 ♂	51	137	131	17 mm.
4 ♀	43·5-49	128·5-142	117-141	15-17 mm.

Mr. La Personne reports that the Blue-bearded Bee-eaters were spread over a wide area in the Vizagapatam district and that they were very partial to the Silk-Cotton trees from which they made sallies after insects. They were also met in the Shevaroys and in the Chitteri Range where they appeared to be uncommon and low level birds, haunting very dense forests. The only other record on this side is by Jerdon (B. of I., i, 212) who says that on one occasion he met the species on the Nackenary Pass leading from the Carnatic into Mysore at about 1,400 ft.

In the western side of the Presidency it occurs in Coorg for Mr. Betts told me (*in epist.*) that a small party were living on the borders of some paddy fields just below his bungalow. Both Jerdon and William Davison noted it in the Wynaad and on the slopes of the Nilgiris, the former up to 3,000 ft., the latter up to about 5,000 ft. A male from Sigur (10, vi, 67) and three birds from Kullar (October-November 1867) are in the Hume Collection. Col. H. R. Baker (Birds of Southern India, p. 174) states that he procured one specimen only on the Sigur Ghat at 4,000 ft., and this specimen is now in my collection.

Fairbank says (S.F., v, 394) that in December 1866 he obtained it at the head of the Kambam Valley which skirts the Palnis along their south-eastern base, besides observing a pair at Periur on the Lower Palnis in March. On the subsequent visit however he was unable to find it at all. Terry does not give it in his Palni list, and all that Ferguson knew about it in Travancore was derived from the labels of some old specimens in the Museum at Trivandrum. The Blue-bearded Bee-eater is presumably a resident in the Presidency but nothing is recorded about the breeding season, except that one of the February females from Anantagiri had the organs enlarged. This species has no races.

Ceryle rudis leucomelanura Reichenbach.

Ceryle leucomelanura Reichenbach, Handb. Alced. (1851), p. 21—Ceylon.

Specimens collected:—788-89 ♀ ♀ 3-9-29, 797 ♂ 799 ♂ 10-9-29 Kodur; 1219 ♀ 10-1-30 Godavery Delta.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
2 ♂	66·5-67	136-138	66·5-68	8·5-10·5 mm.
3 ♀	69-70	139-140	65-71	10-10·5 mm.

The Pied Kingfisher is not yet recorded in the Presidency north of the Godavery Delta, over the whole of which La Personne reports it to be common, extending also up the river. In Cuddapah he saw it at suitable waters all over the district. About Madras, Dewar reports it as very common. On the eastern side of the Presidency right across to the foot of the Nilgiris and the eastern base of the Palni Hills it is doubtless far more generally distributed on suitable waters than these records illustrate. Nothing has been recorded about the breeding season in this area.

On the western side the Pied Kingfisher is common in Coorg on the Cauvery and other big streams (Betts). Hume believed (S.F., x, 352) that it occurred in the Wynaad. A specimen from Calicut (Tweeddale Collection) is in the British Museum. In Travancore it is common along the backwaters.

I have seen no specimens from Coorg or the Wynaad, but Travancore specimens as well as the above Calicut bird are clearly separable from Indian birds generally and must be considered as furnishing another example of the local Travancore races. They are much darker looking birds giving a general impression of black spotted with white on the upper parts, whereas in Indian birds the general impression is white spotted with black. Not only is the actual extent of the white markings much smaller but they are a less pure white, sometimes almost smoky grey in tint. The black spotting on the flanks also tends to be more extensive. The series from Ceylon in the British Museum is not very good but it is sufficient to show that *leucomelanura* is the pale form, agreeing with Indian birds generally. I therefore propose for the above Travancore race the name

CERYLE RUDIS TRAVANCOREENSIS Subsp. nov.

Type:—Travancore (Surgeon-General Fry), British Museum Reg. No. 1910. 5.11.34.

Alcedo atthis taprobana Kleinschmidt.

Alcedo ispida var. *taprobana* Kleinschmidt, Orn. Monatsb., vol. ii (1894), p. 126—Ceylon.

Specimens collected:—780 ♀ 1-9-29, 798 ♂ 10-9-29 Kodur; 1096 imm. 13-12-29 Cumbum Valley.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
♂	43·5	72	33	8·5 mm.
♀	45	72·5	32	8 mm.

With the exception of Dewar's statement that the Common Kingfisher is very numerous at Madras, the above specimens provide the only definite records for the eastern side of the Presidency, though it is probably more common and more generally distributed than this fact would lead one to believe.

On the western side it is common in Coorg, the Wynaad and the Nilgiris and I possess a specimen from the Palghat gap. In the Nelliampathies, Kinloch considered it very rare, found only on perennial streams on the plateau. Fairbank did not meet with it in the Palnis, but Terry observed a pair near the Goondar stream in the Pittur Valley. In Travancore it is common about the backwaters everywhere and also about tanks and ponds in the low country, though it does not ascend the hills.

Ferguson's statement that the Kingfisher breeds in March in Travancore appears to be the only information about the breeding season in the Presidency.

All the specimens which I have examined from the Presidency, south of the Godavery River, most certainly belong to the very blue Cinghalese race and not to *Alcedo a. bengalensis.*

Alcedo meninting subsp.?

Alcedo meninting Horsfield, Trans. Linn. Soc., vol. xiii (1821), p. 172—Java.

Beavan's Kingfisher was not procured by the Survey and it appears to be very local in the Presidency. William Davison (S.F., x, 351) thought that he recognised one on the banks of a small stream between Goodalore and Nellacotta in the Wynaad. Bourdillon and Ferguson considered it not uncommon in Travancore where it is confined to the small patches of paddy cultivation and the streams which irrigate them about the base of the hills. A specimen from the Mynall Estate (Bourdillon) is in the British Museum, as is also a male collected by Theobald on 18 October 1868 at Pothanore in Salem district. Nothing is known as to the status of Beavan's Kingfisher in the Presidency but it is presumably a resident, as Stuart Baker records eggs taken by Stewart in Travancore at 2,000 ft. on 17th January (*New Fauna*, iv, 255; *Nidification*, iv, p. 409).

There is a good deal of difficulty over the identification of the form of Beavan's Kingfisher which occurs in the Presidency. Mr. Stuart Baker is of opinion that two forms occur (*New Fauna*, iv, pp. 255-56) namely his Ceylon race *phillipsi* to which he attributes the Pothanore bird and the Mynall bird and *A. m. asiatica* which he considers occurs from the rest of Travancore northwards to Belgaum.

I have unfortunately been unable to inspect the Tring collection and the series of 9 birds from Ceylon on which Mr. Stuart Baker bases his race *phillipsi*. There is only one specimen from Ceylon in the British Museum. I have therefore been unable to complete my examination of this group, which does however suggest to me that the number of races recognised in the *New Fauna* are too many. Of the two Presidency specimens mentioned above the Mynall bird agrees well enough with the single Ceylon specimen examined. The Pothanore bird on the other hand is quite different, being a deeper blue in colour, agreeing far better with the Javan form. For the present therefore I do not feel justified in attributing Presidency birds to any particular race.

[**Ceyx erithaca** (Linnaeus).

Alcedo erithaca Linnaeus, Syst. Nat., ed. x (1758), p. 115—Bengal.

The Three-toed Kingfisher is included by Inglis and Baker in their Birds of Southern India without comment and presumably on the authority of the *New Fauna* (iv, 260) where it is said to occur in 'Ceylon, Travancore and the Malabar Coast to Kanara'. It is of course well known in Ceylon, but I can find no original record of it from the Presidency beyond Jerdon's statement (B. of I., i, 230) that he obtained it in Southern India. Elsewhere he speaks of this as in the Carnatic. As this species is only authentically recorded from one area in India, namely the Sahyadris towards Bombay (Matheran and Khandala, Kinnear, J.B.N.H.S., xix, 749; Butler, S.F., ii, 455; v, 503; between Ambolee and Danowlee, Butler, S.F., ix, 383), I think further evidence is required for its full inclusion in the Presidency list.]

Ramphalcyon capensis gurial (Pearson).

Halcyon gurial Pearson, J.A.S.B., vol. x (1841 after 11 August), p. 635—Calcutta, Midnapore.

The Brown-headed Stork-billed Kingfisher was not reported by the Survey, and the only record of it in the eastern side of the Presidency appears to be Jerdon's statement (B. of I., i, 223) that it is occasionally found in the Northern Circars and is rarely seen in the Carnatic.

On the western side William Davison tells us that he saw it on some of the larger streams in the Wynaad, though only occasionally. Fairbank saw it twice at the eastern base of the Palni Hills. Ferguson says that in Travancore it is confined to the low country about the foot of the hills, being nowhere abundant.

Nothing is known about the breeding season in the Presidency except that in Travancore Stewart and Bourdillon found eggs in February and March, and Bourdillon also obtained 4 fresh eggs on 20 July (Stuart Baker, *Nidification*, iii, p. 416).

There seems to be only the one race of this species in India proper.

Halcyon smyrnensis smyrnensis (Linnaeus).

Alcedo smyrnensis Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 116—Smyrna.

Specimens collected:—468 ♂ juv. 23-6-29 Tirthamalai 1,000 ft.; 841 ♀ 20-9-29 Kodur; 978 ♂ 7-11-29 Nallamalai Range 2,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
♂	60	114	76	14 mm.
♀	58·5	119	79	14 mm.

The Survey has provided us with surprisingly little information about the status of the White-breasted Kingfisher in the Presidency and there is no record of it anywhere north of the Nallamalai Range and Kodur in both of which places single specimens were preserved. In South Cuddapah, Mr. La Personne remarks that it was found frequently in dense forest far from any water, feeding apparently on grasshoppers. About Madras, Dewar found it most abundant, occurring in almost every garden. Southwards, La Personne saw it in the low country around Harur and secured the above specimen at Tirthamalai. Nothing is recorded about the breeding season.

The Survey specimens cannot be distinguished from north-western birds in colour though they appear to be smaller. 8 Punjab specimens measure:—bill from skull 59-66 mm., wing 122-129 mm., tail 75-87 mm. These figures suggest the existence of a northern and a southern race, depending on size, but before recognising it one would require to see more birds from the Presidency.

Apart from this detail, I disagree with Stuart Baker's treatment of this species. He confines the typical race in India to the north-west, viz., Baluchistan, Sind, Punjab and Kashmir, separates birds from Ceylon and the extreme south of Travancore as *Halcyon s. generosa* Madarasz, and attributes birds from the whole of the rest of India, Burma and farther east to an intermediate race *H. s. fusca.*

This is unsatisfactory. It is quite impossible to distinguish Ceylon birds from those found along the western side of the Presidency in the rain area from Coorg to the south of Travancore. They differ neither in size nor in the rich darkness of the chocolate brown parts of the plumage (I can see no difference in the colour of the back of this species anywhere in India; the tint of blue varies individually and is also affected by wear). For these birds the oldest name is *Alcedo fusca* Boddaert. The birds from the whole of the rest of India, including the north-west, appear to me to belong to one form in which the chocolate-brown is definitely paler, though individuals differ a little *inter se.* As stated above these will probably prove to be divisible on size into a northern and southern race.

Halcyon smyrnensis fusca (Boddaert).

Alcedo fusca Boddaert, Table Pl. Enlum. (1783), p. 54, based on Pl. Enlum., 894—Malabar.

If my views expressed above are correct, this race of the White-breasted Kingfisher is entirely confined to the west of the Presidency from Coorg to Cape Comorin. In Coorg according to Betts it is common and there is a specimen from here in the Tweeddale Collection in the British Museum.

A male obtained on 29-3-1881 by William Davison at Nellacotta is in the British Museum. He says (S.F., x, 351) that at the base of the Nilgiris, especially in the better-wooded parts it is not uncommon but that it is only a straggler to the tableland where he had shot it two or three times at Ootacamund.

Fairbank saw it at Periur in the Lower Palnis, and Terry saw one near the Goondar stream in the Pittur Valley.

In Travancore, according to Ferguson, it is the commonest Kingfisher. It appears however never to ascend to any height in the hills, being found in the small patches of paddy cultivation and on the banks of the larger streams. Bourdillon adds that it lays about the beginning of April.

Halcyon pileata Boddaert.

Alcedo pileata Boddaert, Tabl. Pl. Enlum. (1783), p. 41 based on Pl. Enlum., 673—China.

The Black-capped Kingfisher was not procured by the Survey, but it seems to be sparingly distributed round the coasts of the Presidency. Jerdon tells us (B. of I., i, 226) that he once personally shot a specimen at Tellicherry and also had seen others from the same locality. Ferguson had a specimen which was caught alive in a well near Trivandrum (J.B.N.H.S., xii, p. 203; xv, 659).

On the eastern side it must be well established in the Godavery Delta for Roscoe Allen records (J.B.N.H.S., xvi, pp. 373 and 511) that he shot one on 15 January, 1905, on the Naidupalem Creek, a tributary of the Upputeru River which flows into the sea between the Kistna and the Godavery. Another was seen next day near the Lutchmapuram Lock on the Upputeru River, and yet another on the Yelem drain near Cocanada on 13 February, 1905. It follows these rivers some distance inland as Blanford obtained a male near Dumagudiam in the Godavery Valley on 21 February, 1871. This specimen is now in the British Museum.

There appears to be no difference between Indian and Chinese specimens.

Entomothera coromanda coromanda (Latham).

Alcedo coromanda Latham, Index Orn., vol. i (1790), p. 252—Coromandel Coast.

The sole authority for the occurrence of this lovely species, the Ruddy Kingfisher, in the Presidency is the specimen in the Government Museum at Madras which was shot by the superintendent Mr. Edgar Thurston at Guduvancheri about 16 miles south of Madras.[1] It renders unnecessary, however, Blanford's refusal (*Old Fauna*, iii, 135) to accept Latham's name for this species and Oberholser's proposal to designate the type locality as Rangoon on the grounds that the Coromandel Coast must be a mistake.

[**Sauropatis chloris vidali** (Sharpe).

Halcyon vidali Sharpe, Cat. Birds B.M., vol. xvii (1892), p. 278—South Konkan.

The White-collared Kingfisher is included in their *Birds of South India* by Baker and Inglis on the authority of the *New Fauna*, vol. iv, p. 277, where its distribution is given as 'South-west Coast of India. Stewart and Bourdillon both record it from Travancore and it appears to inhabit the coastal region from Travancore to the Konkan.' This race was of course discovered by Vidal in the Ratnagiri district where he found two distinct colonies in the mangrove swamps at Kelsi and Ratnagiri (S.F., vii, 168; viii, 414; ix, 50). The bird was not however found in Kanara by James Davidson nor can I trace any original record of its occurrence anywhere southwards to Travancore. The old E.I.C.'s Museum contained a specimen said to be from Madras but this locality was discredited by Jerdon (B. of I., i, 228). Under the circumstances further evidence seems necessary before this species can be admitted to the Presidency list. I am also very doubtful whether this race can be maintained. Vidal's birds do not appear to differ in any way from the only other Indian specimens in the British Museum, namely four from the Sunderbunds in the Hume Collection and these are usually attributed to *S. c. armstrongi*.]

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[1] This specimen was recorded in the Administration Report of the Madras Government Museum for the year 1902-1903. Guduvancheri is in Chingleput District and the Kingfisher was shot in November.

(*To be continued*).

REVISION OF
THE FLORA OF THE BOMBAY PRESIDENCY.

BY

The late E. Blatter, s.j., Ph.D., f.l.s.

Part XXVI.

(Continued from page 548 of this volume).

CYPERACEAE

BY

The late E. Blatter, s.j., Ph.D., f.l.s., and C. McCann, f.l.s.

(With two plates).

9. Bulbostylis Kunth.

(*Stenophyllus* Rafin. Cke. ii, 886.)

Annual herbs; rhizome short or 0. Stems tufted, leafy only at the base. Leaves very narrow, rarely absent; sheaths usually finely hairy. Spikelets of few to many flowers, flattened in umbelled or congested corymbs, sometimes reduced to a solitary one. Glumes imbricate on all sides, 1-2 lowest empty, the uppermost few tabescent, the intermediate 2-sexual. Hypogynous bristles 0. Stamens 1-3, usually 2. Style 3-fid, deciduous, as long as the nut, with a small bulbiform base which remains as a minute button on the apex of the nut when the style falls off. Nut obovoid, 3-gonous, smooth, hardly stalked.

Species about 70.—Most warm regions.

Key

1. Spikelets in a capitate head	1. *B. barbata.*
2. Spikelets in a lax umbel or compound umbel. Stem glabrous below the inflorescence ...	2. *B. capillaris* var. *trifida.*
3. Spikelets in a contracted umbel or compound umbel. Stem pubescent below the inflorescence	3. *B. puberula.*

1. **Bulbostylis barbata** Kunth Enum. ii (1837) 208.—*Stenophyllus barbata* Th. Cooke in Fl. Bomb. Pres. ii, 887.—For synonyms see C. B. Clarke in Hook. f. vi, 651.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Cooke).—*Gujarat*: Nadiad Farm (Bhide !); Ahmedabad, very common (Saxton 1728 !, Cooper !).—*Deccan*: Karli (Woodrow ex Cooke).—*S. M. Country*: Badami (Herb. St. X. C. 3116 !, Woodrow or Cooke !, H.E.B.B. !); Badami Hills (Paranjpye !); Gokak (Shevdye !); Hubli, 2,000 ft., rainfall 30 in. (Sedgwick 4982 !).—*N. Kanara*: Karwar, common on sandy soil (Talbot 555 ! 1314 !, Sedgwick 6592 !, Bell 2700 !, Hallberg & McCann C145 !).

Flowering & fruiting: July 1917 (Karwar); July 12th, 1919 (Ahmedabad); August 10th, 1883 (Karwar); August 17th, 1909 (Gokak); August 30th, 1892 (Badami); September 1st, 1912 (Badami); September 27th, 1913 (Ahmedabad); October 1911 (Nadiad); October 1919 (Karwar); December 1918 (Hubli).

Field notes: A monsoon species. In the northern part of the Presidency it dies down soon after the monsoon, but may be found near water at later periods. A plant that prefers sandy soil.

Distribution: Throughout India.—Ceylon, warm regions.

2. **Bulbostylis capillaris** Kunth var. **trifida** C. B. Clarke in Hook. f. F.B.I. vi, 652.—For synonyms see C. B. Clarke l.c.

Description: A densely tufted annual. Stems 5-30 cm. long, setaceous, at the top glabrous. Leaves half as long as the stems, setaceous; sheaths with long white hairs in the throat. Spikelets in a simple or compound lax umbel, all solitary, or in weak examples, only 3-1 to a stem; bracts setaceous, short. Spikelets usually 3 by 1.25 mm., about 12-flowered, but vary from 1.25 to 6 mm., from dark brown to pale brown. Glumes boat-shaped, ovate, hardly acute, nerveless, pubescent; keel pallid. Stamens usually 2; anthers narrow-oblong, muticous. Style as long as the nut, filiform, glabrous; branches 3, long. Nut 2/5 the length of the glume, trigonous, obovoid, truncate, pallid or pale brown, smooth, without vertical or transverse undulate lines, or the transverse undulations faintly indicated; outermost cells short oblong longitudinally; style-base persistent on the nut as a small depressed ovoid button.

Locality: *W. Ghats*: Khandala (Gammie 15424 !); Mahableshwar, summit of Sindola, 4,700 ft., rainfall 300 in. (Sedgwick 4844 !), hillsides (Sedgwick 4672 ! 4673 !); Panchgani (Blatter & Hallberg B1742 ! B1744 !); Purandhar Fort (Bhide !); Castle Rock (Bell 4289 !).—*S. M. Country*: Astoli, open ground in forest (Sedgwick 2554 !).—*N. Kanara*: Karwar (Hallberg & McCann C146 !).

Flowering & fruiting: July 1917 (Astoli); September 1918 (Castle Rock); September 7th, 1907 (Purandhar); September 20th, 1902 (Khandala); October 1919 (Karwar); October 1920 (Panchgani); November 1918 (Mahableshwar).

Distribution: Very common from the Himalaya, 8,500 ft., to Ceylon.—Warm regions of the Old World.

3. **Bulbostylis puberula** Kunth Enum. ii (1837) 213; C. B. Clarke in Hook. f. F.B.I. vi, 652.—*Ibidem* see synonyms.

Description: A densely tufted annual. Stems 5-30 cm. long, setaceous, at the top hairy. Leaves half as long as the stem, setaceous; sheaths with long white hairs in the throat. Spikelets in a simple or compound umbel very nearly contracted into a head; the pedicels of the solitary spikelets often only 1.25-2.5 mm. long; bracts long or short, setaceous. Spikelets 5 mm. long, 10-flowered, oblong, dark brown. Glumes boat-shaped, ovate, hardly acute, pubescent. Style 3-branched. Nut ⅓ the length of the glume, trigonous, obovoid, truncate, pallid, transversely marked by wavy lines; style-base persistent on the nut, small, ovoid, depressed, dark red.

Locality: *N. Kanara*: Karwar, on sandy soil (Talbot 1314 ! 1512 !); sandy fields by the sea (Sedgwick 5089 !, Bell 2699 !).

Flowering & fruiting: July 1917, August 10th, 1885, October 1st, 1885, December 1918 (Karwar).

Distribution: N. Kanara, near the coasts of Madras Pres., Travancore, Malay Peninsula.—Ceylon, tropical Africa, Mascarene Islands, Malaya, Cochin China.

10. SCIRPUS Linn. Cke. ii, 890.

Species 200.—Cosmopolitan, characteristic of wet moors, bogs and marshes.

Cooke describes 11 species from the Presidency. Of these we have united *S. Kysoor* with *S. grossus*, and *S. Micheliamus* with *Juncellus pygmaeus*. Four species new to the Presidency have been added: *S. holoschoenus*, *S. erectus*, *S. mucronatus*, and *S. triqueter*.

Key

A. Large or middle sized. Stems leafy only near the base. Spikelets in clusters. No trace of hypogynous bristles. Style long, trifid ... 1. *S. holoschoenus*.

B. Large or middle sized. Stems leafy only near the base. Inflorescence various, but spikelets not spicate. Hypogynous bristles often present. Style long

I. Nut marked with transverse wavy lines; hypogynous bristles 0

1. Stems flowering nearer to the top than the base, slender, obtusely trigonous; glumes 2.5 mm. long, with tapering (not subcordate) base, not inflated in front, strongly keeled ... ... 2. *S. supinus.*

2. Stems stout, septate when dry, head usually near the base of the stem. Nut triquetrous ... ... 3. *S. articulatus.*

3. Stems rather slender, head usually above the middle of the stem. Spikelets yellowish, flaccid, glumes 5-ranked, concave, inflated in the upper part. Nut triquetrous 4. *S. quinquefarius.*

II. Nut not marked with transverse wavy lines

1. Hypogynous bristles 0 ... ... 5. *S. corymbosus.*

2. Hypogynous bristles present

a. Hypogynous bristles retroversely scabrid (not plumose)

† Glumes bifid at apex

§ Bristles usually somewhat shorter than the nut, often unequal ... 6. *S. maritimus.*

§§ Bristles often about as long as nut 7. *S. triqueter.*

†† Glumes not bifid at apex ... 8. *S. grossus.*

b. Hypogynous bristles plumose ... 9. *S. littoralis.*

III. Nut more or less distinctly marked with transverse wavy lines. Hypogynous bristles present

1. Stems stout, septate wren dry, head usually near the apex of the stem. Nut triquetrous ... ... 10. *S. mucronatus.*

2. Stems medium, heads usually near the apex of the stem; spikelets few, terete, turgid, ovate, acute; glumes broad, incurved, shortly aristate. Nut plano-convex or biconvex ... ... 11. *S. erectus.*

C. Small tufted herbs with slender stems, never reaching 30 cm.; hypogynous bristles 0

I. Perennial herb ... ... 12. *S. kyllingoides.*

II. Annual herb; glumes trapeziform; cusp as long as the blade; bracts 1-3, reaching 2.5 cm. long ... ... 13. *S. squarrosus.*

1. **Scirpus holoschoenus** Linn. Sp. Pl. 72; C. B. Clarke in Hook. f. F.B.I. vi, 655.—*Ibidem* synonyms.

Description: Rhizome horizontal, woody, covered by ovate chestnut scales; fibrous roots thick, often (when growing in sand) woolly. Stems 20-75 cm., approximate, terete. Leaves all near the base of the stem, sometimes 15 cm. long, usually shorter, or reduced almost to sheaths. Umbel simple or very compound of 1-80 usually (2-10) heads; lowest bract sometimes 10-20 cm., sometimes 8-25 mm. Spikelets scarcely 5 mm., ellipsoid, dense-flowered. Glumes ovate, keel subexcurrent, tip hairy (rarely glabrous). Stamens 3; anthers red-crested. Nut small, as long as $\frac{1}{2}$-$\frac{2}{3}$ glume, subtriquetrous, obtuse, minutely apiculate; outermost cells minute, quadrate-hexagonal, obscure, withering (nut more or less white-veiled by such withered fragments on the dark nut).

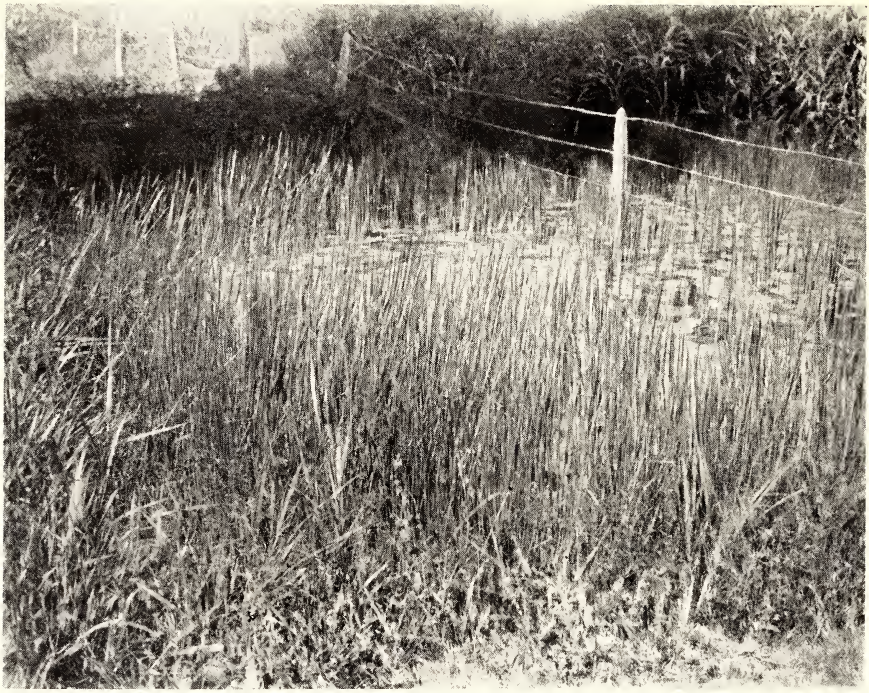
Locality: *Sind*: (Pinwill ex Clarke).

Distribution: Punjab, Sind.—W. Asia, Africa, Europe.

2. **Scirpus supinus** Linn. Sp. Pl. (1753) 49; Cke. ii, 892.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 655.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Cooke).—*Gujarat*: Dakor (Karnitkar ex Cooke). —*W. Ghats*: Igatpuri (Blatter & Hallberg 3207 !); Khandala, in marsh land



Scirpus articulatus L. in a pool near Malad, Salsette Island.

Photos by *C. McCann.*

Scirpus corymbosus Heyne, Tableland, Panchgani.

(McCann C11 !), in a marsh near station (McCann 383 ! 386 ! 387 ! 390 !); Lonavla (Blatter, Hallberg & McCann 28387 !); Panchgani (Blatter & Hallberg B1499 !).—*Deccan*: Varawandi, Ahmednagar Dist. (Herb. Sedwgick & Bell 7368 !); Bairawadi, Purandhar (Blatter & McCann 5579 ! 5581 !).—*Konkan*: (Law ex Cooke); Kalyan (H.E.B.B. !, Woodrow ex Cooke); Nagothna to Pen (Gammie 16088 !); Pen (Blatter, Hallberg & McCann 3226 !); Bansda (Woodrow ex Cooke).—*S. M. Country*: Devarayi (Sedgwick 4420 !); Yelvigi, Dharwar Dist. (Sedgwick 3701 !).—*N. Kanara*: Karwar, rice fields (Sedgwick 6719 !, Talbot 1115 !, Hallberg & McCann C178 ! C179 !).

Flowering & fruiting: January 1917 (Igatpuri); February 1917 (Pen); February 1918 (Yelvigi); February 1920 (Varawandi); March 1929 (Khandala); September 4th, 1896 (Kalyan); October 1918 (Lonavla, Devarayi); October 1919 (Karwar); October 1920 (Panchgani); November 1918 (Khandala); December 1917 (Bairawadi); December 14th, 1902 (Nagothna to Pen).

Field notes: A plant commonly met with in marshes throughout the year. Usually partially in water. Spikelets pale green or straw-coloured.

Distribution: More or less throughout India, except Assam—Old World generally and in America.

Var. **uninodis** C. B. Clarke in Hook. f. F.B.I. vi, 656; Cke. ii, 892.—*S. mucronatus* Roxb. Fl. Ind. i (1832) 216 (*non* Linn.).

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Clarke).

Distribution: Bengal, Sind, Coromandel.—Ethiopia, Java, Queensland.

3. **Scirpus articulatus** Linn. Sp. Pl. (1753) 47; Cke. ii, 891.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 656.

Description: Cke. l.c.

Locality: Without locality (Dalzell !).—*Sind*: (Pinwill ex Cooke).—*Gujarat*: Godhra (Chibber 593 !); Talod, marshy land near tank (Saxton 568 !); Sonasan, by a small tank (Sedgwick 329 !); Dakor (Karnitkar ex Cooke).—*W. Ghats*: Khandala (McCann 27447 !).—*Konkan*: (Woodrow ex Cooke); Sion (Blatter & McCann 3071 !); Uran, Bombay Harbour (Hallberg & McCann 2740 !); Bandra (Herb. St. X. C. 3080 !); Kondita, Salsette (Blatter & McCann 3081 !); Borivli (Chibber !); Pali to Nagothna (Gammie !); Gokhirwa, Bassein (Ryan 85 !); Borivli, in a ditch (McCann 1118 ! 1118a ! 1118b ! 1119 ! 1119a !); Goregaon to Malad, in a ditch (McCann 1348 !); near Malad in a ditch (McCann 1357 !); Varol Tank, Bhivandi, near Kalyan (McCann 1727 !); Bhivandi (Chibber !).—*S. M. Country*: Havasbhavi, 2,000 ft., rainfall 35 in. (Sedgwick 1949 !) tanks W. of Kunnur, Dharwar Dist. (Sedgwick 4919 !); Kulgeri, tank (Bhide !).—*N. Kanara*: Karwar, on edge of tank (Hallberg & McCann C10 !); Kumpta, rice fields (Talbot !).

Flowering & fruiting: January 1917 (Uran); January 2nd, 1912 (Borivli); January 30th, 1912 (Bhivandi); May 1919 (Khandala); September 6th, 1911 (Dharwar); September 15th, 1929 (Borivli); September 29th, 1929 (Goregaon to Malad; near Malad); October 1919 (Karwar); November 1916 (Sion); November 21st, 1902 (Gokirwa, Bassein); December 1902 (Pali to Nagothna); December 1915 (Sion, Bandra); December 1916 (Kondita, Havasbhavi); December 1918 (W. of Kunnur); December 5th, 1907 (Godhra).

Field notes: A late comer among the *Cyperaceae*. Flowering takes place about the first week of September. The plants first appear in July and August, but at this time life is spent under water, and the juvenile state does not look anything like one of the *Cyperaceae*. The leaves in the juveniles never appear above the water; they are long, tufted, ribbon-like structures. Soon after the inflorescence appears the leaves decompose and fall away leaving a spathe surrounding each culm. The culms are erect, hollow (not spongy), light green, with thin white septa at intervals. In fresh specimens the septa are as clearly visible as in dried specimens. The height of the inflorescence on the culm depends on the depth of the water at the time when the plant is coming into flower. Thus we have individuals with the inflorescence well up the culms and others with the inflorescence low down near the base. This may be said to be an 'amphibious' species—the early stages being spent under water, while the plant in flower exists on moist ground long after the monsoon.

The Floras give, leaves 0. This is incorrect as the leaves appear before the inflorescence-bearing culms, and unless known to be those of *S. articulatus*, appear to be quite different from those of any of the *Cyperaceae*. Specimens in McCann's herbarium clearly show this. The Borivili specimens are particularly interesting as they show the juvenile state of this species (McCann No. 1118); while McCann No. 1119 proves that the species has leaves.

Distribution: Throughout India.—Ceylon, Africa, Philippines, Australia.

4. **Scirpus quinquefarius** Ham. in Wall. Cat. (1828) 3465; Cke. ii, 892.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Cooke, Blatter & McCann C3113 !, H.E.B.B. !); Rhubak (Woodrow !); Gholam (Blatter & McCann D740 !), in a field (Blatter & McCann D741 !); Tatta (Blatter & McCann D742 ! D743); Bughar, on the Indus (Blatter & McCann D744 !).—*Cutch*: (Stoliczka ex Clarke).—*Gujarat*: (Hove ex Clarke); Ahmedabad (Gammie 16361 !); Munnagar, rice fields, Ahmedabad Dist. (Sedgwick 332 !); Talod (Saxton 708 !); Umrat (Woodrow ex Cooke).—*Deccan*: Varawandi, Ahmednagar Dist. (Herb. Sedgwick & Bell 7370 !); Poona (H.E.B.B. !).—*Konkan*: (Dalzell ex Cooke). Though Cooke has seen a specimen we doubt very much whether this species occurs in the Konkan.

Flowering & fruiting: February 1920 (Varawandi); October 24th, 1903 (Ahmedabad); December 1892 (Bhubak).

Distribution: N.-W. India, Central India, W. Bengal, Sind, Cutch, Gujarat, Deccan.—Afghanistan, Baluchistan, Africa.

5. **Scirpus corymbosus** Heyne ex Roth. Nov. Pl. Sp. (1821) 28; Cke. ii, 892. Synonyms in C. B. Clarke in Hook. f. F.B.I. vi, 657.

Description: Cke. l.c.—'Stem round or slightly oval, firm but spongy' (Fernandez).

Locality: Without locality (Dalzell !).—*Sind*: (Pinwill ex Cooke).—*Gujarat*: Kabir Vad, Broach Dist. (Chibber !).—*Khandesh*: Dhulia, Thikki tank (Chibber !).—*W. Ghats*: Panchgani, in rocky pool on Third Tableland (Fernandez C147 ! C148 ! C149 !), in mud along banks of monsoon pools (Fernandez C150 ! C151 !), Second Tableland (Blatter & Hallberg B1733 !).—*Goa*: (Herb. St. X. C. 3112 !, Herb. Woodrow !).

Flowering & fruiting: September 28th, 1928 (Panchgani); October 1920 (Panchgani); November 26th, 1929 (Panchgani); December 10th, 1907 (Kabir Vad); December 28th, 1907 (Dhulia).

Field notes: A tall densely growing species with terete striate spongy stems. At Panchgani we have found this species forming almost pure associations in the shallow pools and lakes on the tablelands. It commences to flower in September and remains erect long after the monsoon, even after the pools have dried up. The roots are densely matted in the clayish soil. Here we have found it associated with *Eleocharis fistulosa* Link.

Distribution: Bundelkhand, Sind, Gujarat, Khandesh, Deccan, N. Kanara, Mysore.—Africa, Madagascar.

6. **Scirpus maritimus** Linn. Sp. Pl. (1753) 51; Cke. ii, 893.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 658.

Description: Cke. l.c.

Locality: *Sind*: (Dalzell & Stocks 1094 ex Cooke); Karachi (Woodrow ex Cooke, H.E.B.B. !); Mirpur Sakro (Blatter & McCann D745 ! D746 ! D747 !); Tatta (Blatter & McCann D748 ! D749 !), in a lake (Blatter & McCann D750 !); Bughar, on the Indus (Blatter & McCann D751 !).—*Cutch*: Banner (Blatter 3733 !); Anjar (Blatter 1978 !).—*Gujarat*: Chharod Farm (Javlekar !); Umreth (Clarke !, Woodrow ex Cooke); Godhra (Chibber !), tank (Chibber 347 !); Kabir Vad, Broach Dist. (Chibber !); Kharagoda (Saxton 482b !); Mishwa River Harsol (Sedgwick !).—*Kandesh*: Dhulia (Chibber !).—*Deccan*: Miraj (Woodrow ex Cooke).—*Konkan*: Bombay (Woodrow ex Cooke), race-course (Blatter & McCann 3203 !); Mahim (McCann 5265 !); Parsik, railway line (Blatter & McCann 28920 !); Bandra (Herb. Sedgwick & Bell 7400 !); Sion (Blatter & McCann 2376 !); common in marshes near Diva and Kalyan (McCann !); Kurla, in marshes (McCann !).—*S. M. Country*: Tank near Yelvigi, Dharwar Dist., 1,800 ft., rainfall 28 in. (Sedgwick 3605 !).—*N. Kanara*: Haveri (Talbot 2226 !).

Flowering & fruiting: January 1920 (Bandra); January 2nd, 1890 (Haveri); February 1918 (Yelvigi); March 1917 (Bombay); April 26th, 1909 (Chharod); April 29th, 1904 (Karachi); June 1917 (Sion); August 1914 (Harsol); October 11th, 1914 (Kharagoda); November 9th, 1907 (Godhra); November 15th, 1916 (Mahim); November 29th, 1907 (Godhra); December (Bombay); December 1907 (Banner); December 1907 (Anjar); December 1915 (Sion); December 1918 (Parsik); December 10th, 1907 (Kabir Vad); December 28th, 1907 (Dhulia).

Field notes: The typical form is the commonest in marshes near the sea and also inland. It is extremely common in the beds of tanks and pools that dry up during the dry season, flowering after the water has dried but when the soil is still marshy. The plants arise in tufts or singly from the long rhizomes. A tough plant usually persisting throughout the dry season and breaking up in the next monsoon.

Uses: 'The seeds are used and the plant produces them abundantly' (Gammie).

Distribution: Kashmir, Kashgar, Moradabad, Rajputana Desert, Bombay Presidency, Mysore, Nellore.—Old World, with varieties in Australia and America.

var. **affinis** C. B. Clarke in Hook. f. F.B.I. vi, 659; Cke. ii, 893.

Description: Cke. l.c.

The Sangli specimens have from 4 to 5 spikelets.

Locality: *Sind*: (Dalzell ex Cooke, Stocks 82 ex Clarke, Pinwill ex Clarke).—*Gujarat*: Ahmedabad (Chibber !, Saxton 1819 !); Surat (Gammie 16448 !); Sabarmati (Sedgwick !).—*Khandesh*: Bhusawal (Gammie !).—*Deccan*: Nasik (Clarke 4 !, Cooke).—*Konkan*: Bombay (Law ex Cooke); race-course (Blatter, Hallberg & McCann 3200 ! 3203 !).—*S. M. Country*: Kudchi, near Miraj (Blatter 3111 !); Sangli, riverbank (Blatter C40 ! C41 ! C42 !); Kolhapur Wadi (H.E.B.B. !); Bagalkot, riverbank (H.E.B.B. !).

Field notes: This variety is the common form met on riverbanks and is extremely variable. Some of the specimens appear to be intermediate between the variety and the typical form.

Distribution: Throughout N. India, in the plains, from the Punjab and Bombay to Assam and Pegu.—N. Asia, Turkestan, N. China, Amurland.

7. **Scirpus triqueter** Linn. Mant. 29; C. B. Clarke in Hook. f. F.B.I. vi, 658.

Description: Glabrous, stoloniferous. Stem 25-75 cm. long, nearly leafless, triquetrous at the top, with one lateral head, or a simple umbel of heads; lowest bract as though a continuation of the stem, triquetrous, 2.5-7.5 cm. long, acute. Spikelets 3-10, up to 1.3 by 0.5 cm., cylindric, obtuse, brown. Glumes ovate, scarious at the tip, notched, with a minute bristle in the notch; hypogynous bristles 3-4 (or 6), often overtopping the nut, dark brown, obscurely scabrous. Stamens 3; anthers linear-oblong, not crested. Nut more than half the length of the glume, obovoid, much dorsally compressed, pale, finally brown, smooth; style shorter than the nut; branches 2, long, sparingly papillose, slightly fusiform.

Locality: *Sind*: (Pinwill ex Clarke).

Distribution: Kashmir, Baltistan, 6,000-8,000 ft., Sind.—Europe, Central Asia to Japan, S. Africa.

8. **Scirpus grossus** Linn. f. Suppl. (1781) 104; Cke. ii, 893.—*S. Kysoor* Roxb. Hort. Beng. (1814) 6; Fl. Ind. i (1832) 230; Cke. i, 894.—*S. grossus* var. *Kysoor* C. B. Clarke in Hook. f. F.B.I. vi, 660.

Description: Cke. l.c. See also Haines Bot. Bih. & Or. 927.

In the Poona Herbarium we examined 23 sheets including 4 sheets determined by Clarke in 1896 (May 1st, 1896) as *S. grossus* Linn. f. The hypogynous bristles in these cases are plumose or shortly ciliate. In the remainder they are plumose or ciliate. Another specimen obtained at Bassein by Ryan has the bristle shortly ciliate. The bristles are generally red. In young specimens we can find no trace of hypogynous bristles which may be developed later.

We are quite unable to distinguish between *S. grossus* and *S. Kysoor* which we think may only be a form. Is this character alone, namely the presence of plumose bristles, sufficient to make a new species of one which otherwise answers to the description of *S. grossus*? We do not feel justified in keeping the two apart and therefore unite them under the older name of *Scirpus grossus* Linn. f.

Locality: *Sind*: (Pinwill ex Clarke).—*Deccan*: Poona (H.E.B.B. !); College of Science garden (H.E.B.B. !, Garade 594 !).—*Konkan*: Beds of rivers in both Konkans (Graham ex Cooke); Bombay (Dalzell ex Cooke); Borivli to Kanari Caves, on the margin of a tank, in water (McCann 1097 ! 1098 ! 1101 !); Borivli (Chibber !); Bhandup (Blatter & McCann 2752 !, McCann C45 !); Bassein (Ryan 1853 !, Chibber !); Bhivandi (Bhagawat !); near Kalyan, Varol Tank (McCann 1687 !).

Flowering & fruiting: January 2nd, 1912 (Borivli); June 1892 (Poona); July 24th, 1902 (Poona[1]); September 15th, 1929 (Borivli to Kanari Caves); October 9th, 1903 (Bassein); November 1916 (Bhandup); December 1919 (Bhandup).

Field notes: Purely a marsh sedge appearing during the monsoon. It flourishes best where the soil is soft and sticky. The inflorescences appear in August. The stems are very sharply triquetrous with concavities between the angles. The margins of the leaves and bracts are minutely serrulate, thus offering a cutting edge if brushed the wrong way. The teeth are weak. As the tanks and pools in which they flourish dry up, the plants also dry. During life the plants send out long stolons which produce large tubers, often more than 2.5 cm. in diameter.

Uses: The tubers are much sought after by local people for food. The plant is used for coarse matting in Bengal.

Distribution: Throughout India, except the N.-W.—Malaya, Tonkin, Philippines.

9. **Scirpus littoralis** Schrad. Fl. Germ. i (1806) 142, t. 5, fig. 7; Cke. ii, 894.—Synonyms in C. B. Clarke in Hook. f. F.B.I. vi, 659.

Description: Cke. l.c.

The Tatta specimens were identified as *Fimbristylis ferruginea* by Vakil in the Flora of the Indus Delta.

Locality: *Sind*: (Dalzell ex Cooke); Tatta (Blatter & McCann D737 ! D738 !).—*Kathiawar*: (Mehta ex Drummond ex Cooke); Rajkot (H.E.B.B. !, Cooke).—*Gujarat*: Dharsana (Chibber !); Kharagoda, in a tank, in 3 ft. of water (Saxton 493b !); Watrak River, Modasa Petha (Sedgwick 1172 !); in sandy bed of stream, Gorair Bridge, Chitrasani to Sarotra (McCann 1394 ! 1394a !); Ahmedabad (Burkhill ex Drummond ex Cooke).—*N. Kanara*: Karwar (Talbot !).

Flowering & fruiting: August 30th, 1885 (Karwar); October 11th, 1914 (Kharagoda); October 24th, 1929 (Chitrasani to Sarotra); December 1915 (Watrak River); December 27th, 1911 (Dharasana).

Field notes: A hygrophylous species commonly met with in pools along banks of rivers and tanks. Long leaves are developed under the surface or float near the top of the water. As soon as the water begins to dry the leaves decay and fall away leaving the culm and the inflorescence. The culms remain standing for quite a long period after the rains. Long creeping stolons are given off which frequently make the plant look as though it were growing in rows.

Distribution: Punjab, Central India, Rajputana Desert, Sind, Kathiawar, Gujarat, N. Kanara, Cuddapah, Kurnool, Chingleput, Travancore, up to 2,000 ft.—Ceylon, Persia, Central Asia, Africa, Mediterranean region.

10. **Scirpus mucronatus** Linn. Sp. Pl. 73; C. B. Clarke in Hook. f. F.B.I. vi, 657.—*Ibidem* synonyms.

Description: Glabrous. Roots fibrous, or rarely a horizontal rhizome 10-15 cm. long. Stems tufted, 15-75 cm. long, stout, triquetrous, bearing one apparently lateral head; lowest bract trigonous, appearing as a continuation of the stem, 1.3-9 cm. long. Leaves 0. Spikelets few or numerous 5-13 mm. long, ellipsoid, subacute. Glumes ovate, subacute, nearly entire at the tip. Hypogynous bristles usually 5 (or 6), unequal, some nearly as long as the

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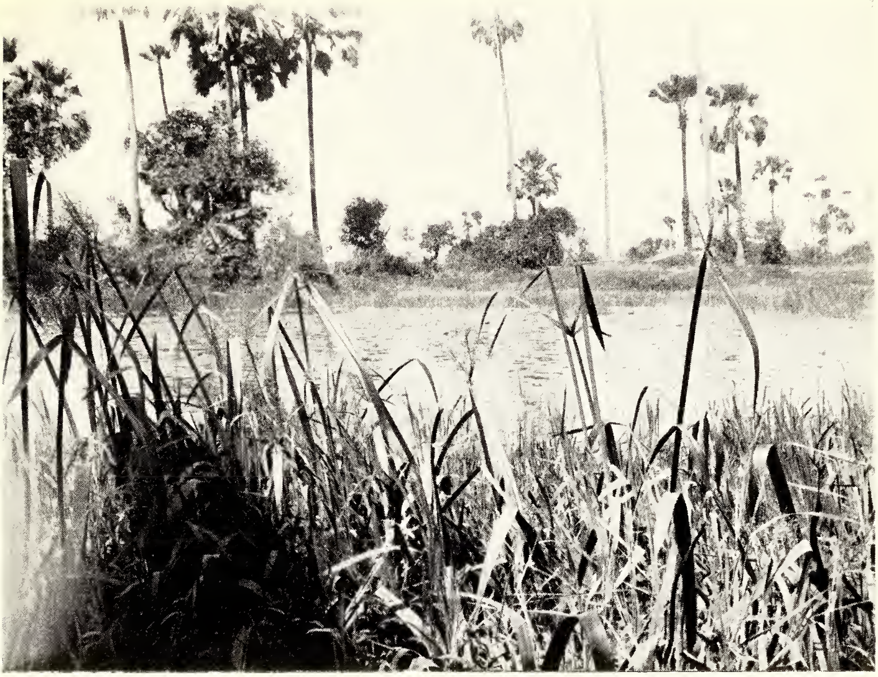
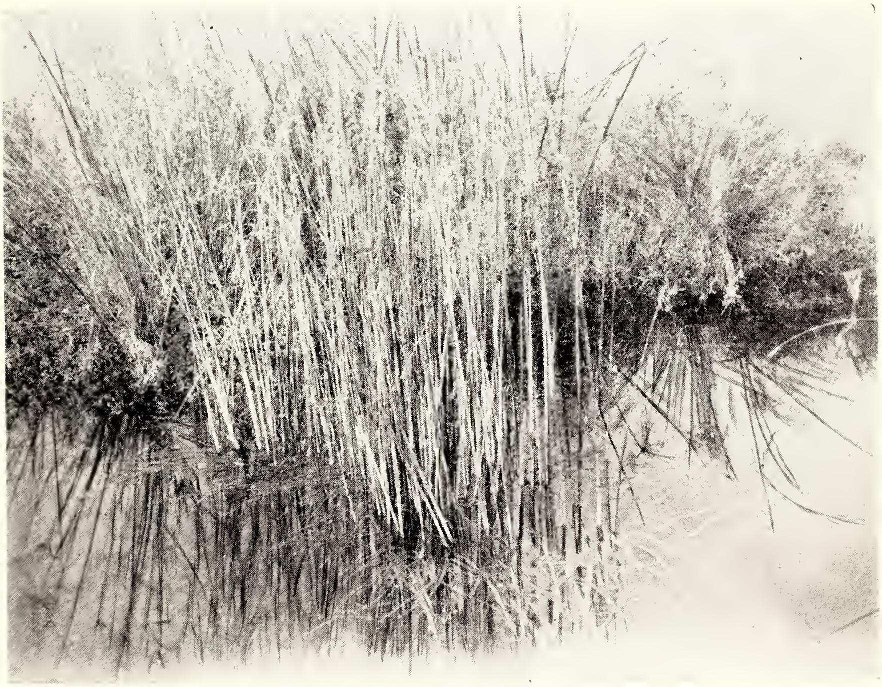
[1] Most of the Poona material is duplicate material or sheets without locality. Only one sheet identified by Clarke bears date and locality.



Inflorescences of *Scirpus grossus* L. near Borivli, Salsette Island.



Photos by C. McCann.

Scirpus litoralis Schrad. Benas River, Abu Road. Note the submerged leaves.

nut, brown, retrorse scabrid (but the bristles are sometimes small and occasionally 0). Style linear; branches 3. Nut less than half the length of the glume, obovoid, trigonous, shining black-chestnut, smooth or obscurely transversely wavy.

Locality: *Gujarat*: The Bokh, Prantij, Ahmedabad Dist. (Sedgwick 1278 !). —*Konkan*: (Law ex Clarke).—*S. M. Country*: Tegur, Dharwar-Belgaum Road, in a nala fed by a perennial stream, 2,000 ft., rainfall 30 in. (Sedgwick 5504 !). —*W. Ghats*: Londa (Gammie 14072 !).—*N. Kanara*: (Talbot 588 ex Clarke); Yellapur (Talbot 588 !).

Flowering & fruiting: March 1919 (Tegur); April 1916 (Prantij); May 21st, 1900 (Londa).

Distribution: Throughout India, up to 6,000 ft.—Europe, tropical Africa, Madagascar, W. Asia to Japan, Australia, Polynesia.

11. **Scirpus erectus** Poir. Encycl. vi (1804) 761; C. B. Clarke in Hook. f. F.B.I., vi, 656.—*Ibidem* synonyms.

Description: Roots fibrous. Stems 10-38 cm. high, terete, tufted, sheaths with an oblique mouth, sometimes produced in a short erect blade. Spikelets 1-3 in a single lateral head near the apex of the stem, 6-13 mm. long. Glumes broadly ovate, acute, concave, keel not very prominent. Bristles 5-6, retrorsely scabrid (rarely 0, C. B. Clarke). Style usually 2-fid. Nut 2 mm. long, planoconvex, broadly obovoid, apiculate, slightly transversely undulate, straw-coloured, brown, ashy-grey, finally usually nearly black.

Locality: *S. M. Country*: Devarayi, in a marsh (Sedgwick 4045 !).—*N. Kanara*: Anmod, rice fields (Sedgwick 3274 !, Talbot 3133 !).

Flowering & fruiting: June 1918 (Devarayi); December 1917 (Anmod).

Distribution: Throughout India.—Ceylon, temperate Asia, N. America, Australia.

12. **Scirpus kyllingoides** Boeck. in Linnaea xxxvi (1870) 733; Cke. ii, 895.

Description: Cke. l.c.

Locality: *N. Kanara*: (Young ex Clarke).

Distribution: N.-W. India, Bengal, Mt. Abu, Rajputana, N. Kanara.—Tropical Africa.

13. **Scirpus squarrosus** Linn. Mant. (1771) 181; Cke. ii, 896.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 663.

Description: Cke. l.c.

Locality: Without locality (Herb. St. X. C. 3108 !).—*Sind*: (Pinwill ex Clarke).—*Gujarat*: Sevalia, Kaira Dist. (Chibber !).—*N. Kanara*: (Talbot 867 !); sandy fields by the sea, Karwar (Sedgwick 5087 !, Talbot 1511 !).—*W. Ghats*: Dudhsagar Falls, near Castle Rock (McCann C128 ! C177 !).

Flowering & fruiting: March 1919 (Dudhsagar); August 1885 (Karwar); December 1918 (Karwar); December 3rd, 1907 (Sevalia).

Distribution: More or less throughout India.—Ceylon, tropical Africa, Java, China.

11. ERIOPHORUM Linn. (Cke. ii, 896).

Species 15.—N. temperate, chiefly in wet moors.

1. **Eriophorum comosum** Wall. Cat. (1828) 3446; Cke. ii, 896.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 664.

Description: Cke. l.c.

Locality: Without locality (Dalzell !).—*Sind*: (Pinwill ex Cooke).—*Gujarat*: Champanir (Woodrow ex Cooke).—*Khandesh*: N. of Chanseli Hill, Taloda taluka (Blatter, Hallberg & McCann 29580 !).—*Deccan*: Shivneri Fort, Junnar (Paranjpye, several sheets !); W. Deccan near Junnar (Dalzell & Gibson); near Junnar (Bhiva ex Cooke).

Flowering & fruiting: March 22nd, 1911 (Junnar); May 10th, 1912 (Shivneri Fort); December 1918 (Chanseli).

Field notes: A densely tufted sedge, growing pendulous from perpendicular rock faces in cracks and fissures. The whole plant is flexuous.

Uses: Used to make ropes.

Distribution: Throughout India.—Tonkin, China.

12. FUIRENA Rottb. (Cke. ii, 897).

Species 25.—Tropics and subtropics.
Key in Cke. ii, 897.

1. **Fuirena Wallichiana** Kunth Enum. ii (1837) 182; Cke. ii, 897.—For snyonyms see C. B. Clarke in Hook. f. F.B.I. vi, 665.

Description: Cke. l.c.

Locality: *Khandesh*: Dhulia, Noti Tank (Chibber !).—*Deccan*: Watery places (Dalzell ex Cooke); Poona (Woodrow 882, Jacquemont 413 ex Cooke, Herb. St. X. C. 3103 !, Garade 648 !, Gammie !, Paranjpye !, H.E.B.B. !); Pashan (Paranjpye !); Varawandi, Ahmednagar Dist. (Herb. Sedgwick & Bell 7388 !); between Nadsur and Pali, in rice fields (Gammie 16038 !).—*S. M. Country*: Dharwar, in clumps of *Pennisetum alopecuros*, 2,400 ft., rainfall 34 in. (Sedgwick 6147 !); Mugadkhan, Hubli, in a canal (Bhide !).—*W. Ghats*: Londa (H.E.B.B. !); Castle Rock (Gammie !).

Flowering & fruiting: February 1920 (Varawandi); July 1919 (Dharwar); July 25th, 1912 (Pashan); September 26th, 1902 (Pashan); October 23rd, 1914 (Pashan); December 8th, 1910 (Hubli, Mugadkhan); December 27th, 1907 (Dhulia).

Distribution: N.-W. India, Central India, Khandwa, Khandesh, Deccan, S. M. Country, N. Coimbatore Hills.

2. **Fuirena ciliaris** (Linn.) Roxb. Hort. Beng. (1814) 81.—*Scirpus ciliaris* Linn. Mant. 182.—*Fuirena glomerata* Lam. Ill. i, 150; Cke. ii, 898.

Locality: *Kathiawar*: Suchipur (Herb. Col. of Sc. now in Calcutta !).—*Gujarat*: Sonasan, in rice fields (Sedgwick 330 !); Godra (Woodrow ex Cooke).—*Konkan*: (Stocks, Law ex Cooke); Bhandup (Blatter & McCann C35 ! 2751 !); Vetora (Sabnis 33764 !); Pen (Blatter, Hallberg & McCann 3230 ! 3231 ! 3233 !); Thana Dist. (Bell 3625 !); Savantvadi (Woodrow ex Cooke); rice fields (Blatter 3105 !); Kulgaum, rice fields (Herb. Woodrow !).—*W. Ghats*: Igatpuri (Blatter & Hallberg 3008 !); Castle Rock, 1,800 ft., rainfall 300 in. (Bell 4353 !); Londa (Herb. Col. of Sc., now in Calcutta !).—*S. M. Country*: Devarayi, 1,800 ft., rainfall 90 in. (Sedgwick 4418 !, McCann C44 !); Byadgi, Dharwar Dist., 2,000 ft., rainfall 33 in., fields (Sedgwick 1972 !).—*N. Kanara*: (Talbot 1032 ex Clarke); Karwar (Talbot 1532 !, Hallberg & McCann C36 ! C37 !); sandy fields (Sedgwick 5094 !); Yellapur (Talbot 779 !).

Flowering & fruiting: January 1917 (Igatpuri); January 1919 (Bhandup); February 1917 (Pen); February 1918 (Thana Dist.); March 1919 (Devarayi); September 1918 (Castle Rock); September 20th, 1884 (Yellapur); September 25th, 1885 (Karwar); October 1902 (Castle Rock); October 1914 (Sonasan); October 1918 (Vetora, Devarayi); October 1919 (Karwar); October 26th, 1883 (Yellapur); November 1891 (Kulgaum); November 1st, 1883 (Yellapur); November 5th, 1891 (Londa); November 1916 (Bhandup); November 1917 (Savantvadi); December 1916 (Byadgi); December 1918 (Karwar); December 9th, 1902 (Nadsur to Pali).

Distribution: Throughout the warmer parts of India, common in rice fields.—Ceylon, tropical Africa, S.-E. Asia, Australia.

3. **Fuirena uncinata** Kunth Enum. ii (1837) 184; Cke. ii, 898.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 666.

Description: Cke. l.c.

Locality: *N. Kanara*: (Thomson ex Cooke); Gersoppa Falls (Hallberg & McCann C38 ! C39 !), on sand (Sedgwick 7148 !); Karwar (Talbot 1312 !), sandy rice fields (Sedgwick 5032 !); Jugglepet (Talbot 1570 !).

Flowering & fruiting: September 20th, 1885 (Karwar); October 1919 (Gersoppa Falls); November 15th, 1885 (Jugglepet); December 1918 (Karwar).

Distribution: N. Kanara, E. districts from Ganjam to Chingleput, Salem and Coimbatore, sea-level to 2,000 ft.—Ceylon.

4. **Fuirena umbellata** Rottb. Descr. *et* Ic. (1773) 70, t. 19, fig. 3; Cke. ii, 899.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 666.

Description: Cke. l.c.

Talbot's No. 1032 was identified by Clarke as *F. glomerata.* We cannot agree. The following is a note by Clarke in Talbot's sheet No. 1032:

'*Fuirena glomerata*, Lam. This has been marked *F. pubescens*, Kunth (doubtless) because the squamellae are 0. The squamellae are difficult to see when very young as in these examples. If the young ovary is soaked in water the 3 young squamellae will separate off it as infinitely thin scarious scales, but having the exact battledore form and nervation of the squamellae as *F. glomerata.* C. B. Clarke. December 1884.'

These sheets are in the herbarium at Calcutta.

Locality: *Deccan*: Alandi (Woodrow ex Cooke).—*W. Ghats*: Castle Rock (Herb. St. X. C. 3104 !, Sedgwick 3397 !, Bhide !, Herb. Woodrow !); Londa (Woodrow ex Cooke), bank of a stream (Bhiva Babajee ! Col. of Sc. now in Calcutta).—*N. Kanara*: Yellapur (Sedgwick 5840 !, Talbot 1032 !).

Flowering & fruiting: April 1919 (Yellapur); October 1919 (Sampkhand, Gersoppa Falls); October 10th, 1884 (Yellapur); November 10th, 1911 (Castle Rock); November 14th, 1890 (Castle Rock); December 1917 (Castle Rock).

Distribution: More or less throughout India.—Ceylon, most warm, not too dry countries.

13. LIPOCARPHA R. Br.

Glabrous herbs; rhizome 0 or short. Stems tufted, obtusely triangular. Leaves grass-like, from the base of the stem only. Spikelets 1-20 in a single terminal bracteate head, many-flowered. Glumes spirally imbricate, 1-2 lowest empty, uppermost few tabescent, intervening bisexual, falling away successively from the base of the persistent rhachilla. Hypogynous bristles replaced by 2 subequal opposite hyaline scales more or less adherent to the nut. Stamens 1-3, usually 2. Style short, slender, stigmas 2, sometimes 3. Nut sessile, plano-convex or trigonous, obovoid or linear-oblong, smooth, usually minutely punctate.—Species 7.—Tropics.

1. Spikelets whitish ... ... 1. *L. argentea.*
2. Spikelets dark chocolate-brown, smaller than the last ... ... 2. *L. triceps.*

1. **Lipocarpha argentea** R. Br. in Append. Tuckey Congo 459; C. B. Clarke in Hook. f. F.B.I. vi, 667.—*Ibidem* synonyms.

Description: Glabrous, annual; stems 15-60 cm. long, tufted, nearly round, each with one head. Leaves ⅓-⅔ the length of the stem, 2.5 by 5 mm. broad, almost without a midrib; bracts 3-4, lowest 2.5-10 cm. long, spreading. Spikelets 1-5 sometimes 10 in the head, usually 6 by 4 mm. (but they lengthen in fruit sometimes up to 2 cm.), dense, with numerous flower-glumes, white or straw-coloured; rhachilla persistent; glumes narrowly obovate-truncate, rather thick, deciduous seriatim from the base or the spikelet leaving the rhachilla prominently covered by lozenge-shaped scars; lower bracteole ⅔ the length of the glume, hyaline, obtuse, 5-nerved, central nerve sometimes green (so thin that if the nut is placed in water the bracteoles enclosing it may be easily overlooked under a microscope); upper bracteoles similar but narrower; stamens usually 2. Nut sessile, shorter than the bracteoles, obovoid-ellipsoid, trigonous, smooth, dark brown, reticulate. Style linear, branches 3, linear, rather short.

Locality: *W. Ghats*: Castle Rock, 1,800 ft., rainfall 300 in. (Sedgwick 3426 !).—*N. Kanara*: Siddhapur, rice fields (Sedgwick 7017 !); Yellapur, Arbail Ghat, 1,800 ft., rainfall 200 in. (Sedgwick 5848 !, Talbot !); Sampkhand (Hallberg & McCann C7 !).

Flowering & fruiting: April 1919 (Yellapur); September 1st, 1884 (Yellapur); October 1919 (Siddhapur, Sampkhand); December 1917 (Castle Rock).

Distribution: From the W. Himalaya, up to 6,000 ft. from the Kangra Dist. to Assam.—Tropics and subtropics of the Old World.

2. **Lipocarpha triceps** Nees in Wight Contr. (1835) 92.—*Tunga triceps* Roxb. Fl. Ind. (1832) 183.—*L. sphacelata* Kunth Enum. ii (1837) 267; C. B. Clarke in Hook. f. F.B.I. vi, 667.

Description: Glabrous. Stems annual, tufted, 10-40 cm. long, trigonous, striated, smooth. Leaves ¼-½ the length of the stem, linear. Spikelets 3-18 in the head, 8 by 3 mm., cylindric, very dense, obtuse, smooth, usually purple or dark reddish, sometimes paler; bracts 3-7, spreading, up to 2.5-10 cm. long. Glumes obovate, with a triangular tip erect or incurved in fruit. Hyaline scales a little shorter than the glumes, lower narrowly elliptic, upper oblong. Nut broadly oblong, round-trigonous, nearly as long as the hyaline scale, black-brown, smooth. Style 0 or hardly any; branches 3, linear, shortly exserted.

'This species was sorted from *L. argentea* (the white-headed) by its deep purple-spotted (sphacelate) heads; but the character is not a safe one any more than the number of spikelets (triceps). The length of the style draws a strong line between the two.' (C. B. Clarke.)

Locality: S. M. Country: Bidi, Belgaum Dist., 2,000 ft., rainfall 50 in. (Sedgwick 3062 !); Havasbhavi, 2,000 ft., rainfall 30 in. (Sedgwick 2156 !).—*N. Kanara*: Sirsi to Siddhapur (Hallberg & McCann C9 ! C46 !); Karwar Dist. (Chibber !); Karwar, rice fields (Talbot 1534 !).

Flowering & fruiting: September 1917 (Bidi); October 1919 (Sirsi to Siddhapur); November 1910 (Karwar Dist.); December 1916 (Havasbhavi).

Distribution: Throughout India, except the dry N.-W., up to 2,000 ft., from Nepal and Assam to Ceylon and Tavoy.—Tropical Africa and America.

14. RHYNCOSPORA Vahl (Cke. ii, 900).

Species 175.—Temperate and tropics.

Cooke has 3 species. His *R. Wallichiana* has to be excluded as the only specimen he has heard of is not this species but *R. Wightiana*. His *R. aurea* has to be changed to *R. corymbosa*.

1. Stem leafy towards the base only. Spikelets in a single terminal head ... ... 1. *R. Wightiana*.
2. Stem leafy throughout its entire length. Spikelets in paniculately arranged corymbs 2. *R. corymbosa*.

1. **Rhyncospora Wightiana** Steud. Cyper. (1855) 148; Cke. ii, 901.

Description: Cke. l.c.

We have examined Woodrow's Kalyan specimen and found it is this species and not *R. Wallichiana*.

Locality: *W. Ghats*: Igatpuri (McCann 2381 !, Blatter & Hallberg 2812 !); Khandala (Jacquemont 649 !, Woodrow ex Cooke), wet grassy banks (Sedgwick 2589 !, McCann 28067 ! 29550 !, Gammie 15401 !, Saxton 1195 !); Lonavla (Bhide !, Chibber !); Castle Rock (Gammie 15699 !, Bhide !).—*Deccan*: Poona (Woodrow ex Cooke).—*Konkan*: (Law ex Cooke); Trombay, on hill (Blatter & McCann 2829 !); Parsik Hill (Blatter & McCann 2360 !); Uran, Bombay Harbour (Hallberg & McCann 2735 ! 3198 !); Thana (Herb. St. X. C. 3101 !); Bassein (Chibber !); Kalyan (H.E.B.B. !); Jutara, Bandra (Ryan 1344 !); Borivli (Chibber !); Thana to Kalyan (Herb. Woodrow !).—*N. Kanara*: Hattikeri, Karwar, rocky hillside (Herb. Sedgwick & Bell 6772 !, Hallberg & McCann C16 !); Sulgeri (Bell 4262 !); Yellapur (Talbot 980 !); Karwar (Talbot !).

Flowering & fruiting: January 1917 (Igatpuri, Uran); July 1917 (Khandala); August 1896 (Khandala, Kalyan); August 1887 (Karwar); August 1918 (Sulgeri); August 10th, 1884 (Yellapur); September 1917 (Trombay, Igatpuri); September 1919 (Thana); September 10th, 1884 (Yellapur); September 10th, 1912 (Borivli); September 18th (Khandala); September 20th, 1902 (Khandala); September 28th, 1903 (Jutara); October 1909 (Castle Rock); October 1917 (Igatpuri); October 1919 (Karwar, Hattikeri); October 8th, 1907 (Lonavla); October 14th, 1909 (Lonavla); October 27th, 1902 (Castle Rock); November 1919 (Trombay).

Field notes: A purely monsoon species confined to open grassland where the grasses are not too tall. Frequently forming pure formations, but generally mixed with grasses and other *Cyperaceae*. When in tall species of grasses it is soon lost; but as the plant commences to flower at the end of July, before the grasses attain to any great height, it does not suffer. In August the nuts are mature, but the plants remain standing till the dry weather.

This species is easily recognised by its rusty-brown head looking at first sight like a Composite.

Distribution: Bombay Pres., Mysore and W. Coast of Madras Pres.—Cochin-China.

2. **Rhyncospora corymbosa** Dom. in Biblioth. Bot. lxxxv (1915) 468.—*R. aurea* Vahl Enum. ii (1806) 229; Cke. ii, 901.—*Scirpus corymbosus* Linn. Amoen. Acad. iv, 303.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 670.

Description: Cke. l.c.

Locality: *W. Ghats*: Castle Rock (Herb. Sedgwick & Bell 5536 !, McCann C18 ! C19 !).—*S. M. Country*: (Young ex Woodrow ex Cooke).—*N. Kanara*: Gersoppa Falls, 1,400 ft., rainfall 200 in. (Herb. Sedgwick & Bell 7954 !, Hallberg & McCann C12 !); Anmod, in rice fields, 2,000 ft., rainfall 200 in. (Sedgwick 3280 !); Ekamli (Gammie 13834 !); Yellapur, bank of river (Talbot 1028 ! 1045 !).

Flowering & fruiting: March 1919 (Castle Rock); April 22nd, 1900 (Ekamli); September 1884 (Yellapur); September 20th, 1884 (Yellapur); October 1919 (Gersoppa Falls); December 1917 (Anmod).

Field notes: A plant of heavy rain forest.

Distribution: Throughout India, except the N.-W.—Ceylon, warm regions of the globe.

15. SCHOENUS Linn. (partim).

Spikelets capitate or panicled; flowers axillary. Glumes (except the uppermost tabescent) distichous; 3 (or more) lowest empty, 1-4 following perfect, nut-bearing, somewhat remote. Hypogynous bristles often present, setaceous, not dilated at base. Stamens 3, anterior. Style 3-fid, gradually passing into the nut without any construction below style-base. Nut in a hollow of the zigzag persistent rhachilla, trigonous.—Species 70.—Australia, New Zealand, a few in Malaya, America, Europe.

1. **Schoenus nigricans** Linn. Sp. Pl. 64; C. B. Clarke in Hook. f. F.B.I. vi, 673.

Description: Almost glabrous. Rhizome horizontal, woody; stolons 0. Stems 10-60 cm., subterete, without nodes except near base. Leaves 10-30 cm., often half stem, very narrow with incurved margins. Spikelets 1-15, almost capitate, 3-13 mm. long, in a close distinctly compound head; lowest bract suberect, often 2.5-10 cm. Hypogynous bristles $\frac{1}{3}$-$\frac{1}{2}$ nut or nearly obsolete. Glumes ovate, obtuse, microscopically hispid on keel, chestnut or brown; 3 lowest empty, 1-3 next nut-bearing; style 3-fid. Nut sessile, ovoid, ellipsoid, marble-white, 1.2 mm., top acutely pyramidal.

Locality: *Sind*: (Pinwill ex Clarke).

Distribution: Kuram Valley, Sind, Punjab.—Nearly cosmopolitan, except S.E. Asia and Australia.

16. REMIREA Aublet (Cke. ii, 902).

Species 1.—Tropics.

1. **Remirea maritima** Aubl. Hist. Pl. Guian. i (1775) 45, t. 16; Cke. ii, 902.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 677.

Description: Cke. l.c.

Locality: *N. Kanara*: (Thomson ex Cooke); Karwar, sandy shore (Hallberg & McCann C1 !, Sedgwick 5083 ! 6677 !); Honavar, sandy shore (McCann C4 !); sandy shore at Sidceshyagud (label illegible), near Karwar (Talbot 552 !).

Flowering & fruiting: August 1st, 1883 (Sidceshyagud, near Karwar); October 1919 (Karwar); December 1921 (Honavar).

Field notes: Purely a sandy shore species almost within tidal limits. Being the only species it is easily recognizable by its very stiff leaves and compact heads. Very common at Karwar and Honavar. It produces long creeping stolons giving off aërial shoots at intervals.

Distribution: Seacoasts in India.—Ceylon, most tropical seacoasts.

17. HYPOLYTRUM L. C. Rich. (Cke. ii, 899).

Species 40.—Tropics and subtropics.

1. **Hypolytrum latifolium** L. C. Rich. in Pers. Syn. i, 70; C. B. Clarke in Hook. f. F.B.I. vi, 678; Fischer Fl. Madras 1673.—*H. Wightianum* Boeck. in Linnaea xxxvii (1871) 130; Cke. ii, 899.

Description: Stem 0.6-0.9 m. high, trigonous. Leaves sometimes longer, acuminate, base narrowed, 1.3-2 cm. wide, margins and midrib below spinulose, especially near the apex; bracts like the leaves, up to 43 cm. long. Spikes sessile or pedunculate in compound corymbose or contracted panicles, oblong-cylindric in flower, sub-globose and lobed in fruit, 5-6.5 mm. long. Empty glume brown with darker dots, oblong or obovate, rounded or subacute, 1.75-3 mm. long, slightly concave, keeled, rigid, male glumes complicate, narrowly boat-shaped or oblanceolate, acute or subacute, 1.25-3 mm. long, membranous or hyaline, keel brownish and more or less ciliate, appressed to the ripe nut; intercalated glumes 0. Nut either fusiform and acuminate, or broadly ovoid, acute or cuspidate, base narrowed or rounded, turgidly biconvex or nearly terete, 2.5-3.5 mm. long, including the inconspicuous or large and patent sometimes swollen beak which is often longer than the nut itself and as broad or broader, often pale and speckled with brown; nut brown, smooth or rugose, sometimes empty.

Locality: *W. Ghats*: Castle Rock (Chibber !, Bhide !, Kanitkar ex Cooke).—*N. Kanara*: (Dalzell ex Cooke); Arbail Ghat, 2,000 ft., rainfall 200 in. (Sedgwick 5124 !); Anmod, watercourse in evergreen (Sedgwick 3239 !); Sampkhand (Hallberg & McCann C5 !); Gersoppa Falls (Talbot 1075 !); Mysore side (Hallberg & McCann C6 !); Gersoppa Road (Chibber !); Yellapur, common in some evergreen near (Talbot 1075 !); Dodmune (Talbot 3596 !); Katgal (Woodrow ex Cooke).

Flowering & fruiting: March 7th, 1896 (Dodmune); March 23rd, 1908 (Castle Rock); April 13th, 1909 (Castle Rock); May 11th, 1911 (Gersoppa Falls); October 1919 (Gersoppa Falls); November 18th, 1884 (Gersoppa Falls); December 1917 (Anmod); December 1918 (Arbail Ghat).

Distribution: Sikkim and Assam to Singapore, Travancore, Ceylon, Nicobars and Andamans.—Malaya, China, Australia, Polynesia.

18. SCLERIA Berg. (Cke. ii, 902).

Plants of open grassland and forests. Those that appear in open places are generally monsoon species, but those in evergreen tracts flourish throughout the year.—Species 160.—Tropics.

Cooke has 6 species. We consider *S. biflora* Roxb. as a variety of *S. tessellata*. The following are new to the Presidency: *S. corymbosa*, *S. poaeformis* and *S. cochinchinensis*.

Key

A. Annuals. Rhizome 0 or very small ... 1. *S. tessellata*.
B. Perennials with woody rhizome
  I. Disk obsolete. Nut smooth
    1. Spikelets in small clusters on a filiform rhachis ... ... 2. *S. lithosperma*.
    2. Spikelets very many, clustered ... 3. *S. corymbosa*.
  II. Disk 3-lobed
    1. Nut smooth
      a. Panicle with many capillary bracteoles 4. *S. hebecarpa*.
      b. Panicle with few or no capillary bracteoles ... ... 5. *S. poaeformis*.
    2. Nut reticulate ... ... 6. *S. cochinchinensis*.
  III. Disk cupular ... ... 7. *S. annularis*.
  IV. Disk 3-6-lobed. Nut cancellately sculptured 8. *S. Stocksiana*.

1. **Scleria tessellata** Willd. Sp. Pl. iv (1805) 315; Cke. ii, 903.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 686.

Description: Cke. l.c.

Locality: *Konkan*: Near Panvel (Jacquemont ex Cooke).

Distribution: Throughout India except the W. arid area.—Ceylon, Malaya, China, Japan, Australia.

Scleria tessellata Willd. var. **biflora** (Roxb.) Blatter *et* McCann *comb. nov.* —*S. biflora* Roxb. Fl. Ind. iii (1832) 573; C. B. Clarke in Hook. f. F.B.I. vi, 687; Cke. ii, 904.

Description: Cke. l.c.

We have made *S. biflora* Roxb. a variety of *S. tessellata* to which it is intimately allied. The leaves are broader, the disk-lobes are larger, and the nut is beaked. But otherwise it is hardly distinguishable.

Locality: *Konkan*: (Woodrow 77 ex Cooke); Foot of hills W. of Mulland, in shade of bushes (McCann 799 ! 893 ! 1268 ! 1269 ! 1282 !); Mulgaum (Blatter & McCann 3661 !, Herb. Sedgwick 3570 !); hills near Matheran (Kantekar !).—*N. Kanara*: Karwar (Talbot !), on pathway (Sedgwick 6626 !), on broken ground on hillside (Sedgwick 6590 !); Ainshi Ghat (Talbot 1506 !).

Flowering & fruiting: July 1919 (Mulgaum); August 11th, 1929 (Hills W. of Mulland); August 12th, 1885 (Ainshi Ghat); August 25th, 1885 (Karwar); September 2nd, 1890 (Hills near Matheran); September 22nd, 1929 (Hills W. of Mulland); October 1919 (Karwar).

Field notes: A monsoon species appearing in July in open places. A curious fact is that it usually grows near bushes, not under, by which it is sheltered from the morning sun. The hairs on the nut are at first white but become ferruginous with age. The stems are erect or decumbent with sharp angles.

Distribution: N. and E. Bengal, Cachar, Konkan, N. Kanara.—Ceylon, Malaya, S. China.

2. **Scleria lithosperma** Sw. Prodr. (1788) 18; Cke. ii, 903.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 685.

Description: Cke. l.c.

Locality: *Konkan*: Hills above Kanari Caves, 1,400 ft., Salsette Isl. (Blatter & McCann 28637 !).—*W. Ghats*: Matheran (Woodrow ex Cooke).—*N. Kanara*: Karwar (Talbot 526 !), in forest on hillside by sea, very abundant (Sedgwick 6511 !), coast forest (Sedgwick 5069 !, Hallberg & McCann C33 !); Guddehulli, Karwar (Sedgwick 6531 !).

Flowering & fruiting: July 10th, 1883 (Karwar); October 1919 (Karwar, Guddehulli); November 1918 (Kanari Caves).

Field notes: Purely a forest species—evergreen forests, growing in dense tussocks. It is easily distinguished from *S. hebecarpa*, which it closely resembles, by its lax inflorescence. It grows all the year round but is not always in flower. Quite common in the higher hills of Salsette where there is evergreen.

Distribution: Throughout India, except the W. arid area, up to 4,000 ft., from Sikkim to Ceylon and Malacca, Andamans and Nicobars.—All warm regions except Continental Africa.

3. **Scleria corymbosa** Roxb. Fl. Ind. iii (1832) 574; C. B. Clarke in Hook. f. F.B.I. vi, 686.—*Ibidem* synonyms.

Description: A stout robust plant, nearly glabrous; culms 0.6-2.4 m. tall. Leaves 30-50 cm. long, 1.3-2.5 cm. wide; sheaths angled or strongly winged. Panicle 45-60 cm. long, of 6 or 7 compound corymbose axillary panicles 7.5 cm. long. Bracts setaceous. Spikelets 6 mm. long, nearly all bisexual. Glumes greenish, pale. Nut ellipsoid, acute at both ends, smooth, white 3 mm. long. Disc small, brown, obscurely 3-lobed.

Locality: *S. M. Country*: Belgaum (Ritchie 869 part ex Clarke).

Distribution: Warm moist region of India, sparsely scattered from Khasia Terai to Ceylon and Malacca; S. M. Country, Rampa Dist., Godavari, Chingleput, Malabar Districts, Travancore.

4. **Scleria hebecarpa** Ness in Linnaea ix (1835) 303; Cke, ii, 904.—Synonyms in C. B. Clarke in Hook. f. F.B.I. vi, 689.

Description: Cke. l.c.

Locality: *Konkan*: (Stocks, Law ex Cooke); Okde Forest, Thana Dist. (Ryan 716 !).—*N. Kanara*: Karwar, coastal forests (Sedgwick 5068 !, Hallberg & McCann C34 !), in forest on hillside by sea, abundant (Sedgwick 6515 !); Gersoppa Falls, 1,400 ft., rainfall 200 in. (Herb. Sedgwick & Bell 7176 !); Sulgeri, 500 ft., rainfall 200 in. (Bell 4261 !); Tinai Ghat (Gammie 15818 !).

Flowering & fruiting: August 1918 (Sulgeri); October 1919 (Karwar, Gersoppa Falls); October 22nd, 1902 (Okde Forest); November 1st, 1902 (Tinai Ghat); December 1918 (Karwar).

Distribution: Throughout India except the N.-W. arid region.—Ceylon, Malaya, China, Japan, Australia, Polynesia.

5. **Scleria poaeformis** Retz. Obs. iv, 13; Fischer Fl. Madras 1679.—*S. oryzoides* Presl. Rel. Haenk. i, 201; C. B. Clarke in Hook. f. F.B.I. vi, 691.—*Ibidem* synonyms.

Description: Glabrous, robust. Stolons elongate, 8 mm. diam., without scales, probably floating. Stems 0.9-1.8 m. long, stout; sheaths 3-winged. Leaves 0.9 m. by 1.7 cm., or the upper 25 cm. by more than 2.5 cm. Panicle apparently terminal without bracts (a small axillary remote one rarely added), 15 by 7.5 cm., dense with innumerable branches and spikelets; usually the upper spikelets on the branches are male, a few of the lower female. Spikelets 6 mm. long, oblong, sessile, a rich brown. Nut 3 mm. diam., subglobose, smooth, white; disc obpyramidal, truncated, with a narrow, rusty brown rim, hardly 3-lobed.

Locality: *N. Kanara*: Birchy (Talbot 1694 !); Tatwal (Talbot 1907 !).

Flowering & fruiting: May 10th, 1888 (Birchy); August 15th, 1889 (Tatwal).

Distribution: S.-E. India, from Assam to Ceylon and Malacca.—Tropical Africa, Malaya, Philippines, Australia.

6. **Scleria cochinchinensis** Druce in Rep. Bot. Exch. Cl. Brit. Isles 1916 (1917) 646; Fischer Fl. Madras 1678.—*S. elata* Thw. Enum. 353.—*Diaphora cochinchinensis* Lour. Fl. Cochinch. 709.—*S. melanostoma* Boeck. in Linnaea xxxviii, 514.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 690 and 692.

Description: A perennial with woody rhizome. Stem stout, sharply trigonous, angles scabrid, up to 1.8 m. high, glabrous. Leaves up to 60 cm. long and 17 mm. wide; sheaths sharply trigonous, those of the midstem often winged, mouth with a short, rounded, coriaceous ligule. Spikelets sessile or peduncled, subsolitary in large, long-peduncled, decompound panicles, 3.5 mm. long. Nuts reticulate, globose or broadly ellipsoid, obtuse or apiculate, 2.5-4 mm. long, white, pale- or dark-brown, sometimes purplish-brown; disk lobes 3, short, rounded.

The specimen obtained by McCann at Castle Rock was about 6 m. high, double the size given by Hooker even for the Var.

Locality: *W. Ghats*: Castle Rock, 1,600 ft., rainfall 250 in. (Sedgwick 2765 !, McCann C32 !, Bhide !, Gammie 15639 !).—*N. Kanara*: Sampkhand, 1,600 ft., rainfall 200 in. (Sedgwick 6970 !, Hallberg & McCann C29 !); Gersoppa Falls (Talbot 2669 !).

Flowering & fruiting: March 1919 (Castle Rock); April 13th, 1909 (Castle Rock); August 1917 (Castle Rock); October 1919 (Sampkhand); October 25th, 1902 (Castle Rock); December 28th, 1891 (Gersoppa Falls).

Field notes: A species of the evergreen forest in the heavy rainfall tracts.

Distribution: Throughout India except the N.-W. arid regions, up to 2,000 ft.—Ceylon, Java, China.

7. **Scleria annularis** Kunth Enum. ii (1837) 359; Cke. ii, 903.

Description: Cke. l.c.

Locality: *Konkan*: (Stocks, Law ex Cooke); Satiwali, Bassein (Ryan 1437 !).—*N. Kanara*: (Law ex Cooke).

Flowering & fruiting: September 21st, 1903 (Satiwali).

Distribution: N.-W. India, Central India, Konkan, N. Kanara, Malabar. —China.

8. **Scleria Stocksiana** Boeck. in Linnaea xxxviii (1874) 474; Cke. ii, 905.

Description: Cke. l.c.

Sedgwick in his paper on the *Cyperaceae* of the Bombay Presidency refers to a form from the red laterite of Talod. We have examined this particular specimen and found the nut cancellate. Though, as Sedgwick remarks, the usual form of the nut is corrugose, we have found that in the same plant the nuts may vary from the common corrugose texture to the cancellate form.

Locality: Without locality (Dalzell !).—*Gujarat*: Talod, red earth upland (Sedgwick 252 !).—*W. Ghats*: Igatpuri (Blatter & Hallberg 2813 !); Khandala, The Saddle (Blatter & McCann 27593 !); Panchgani, Tableland (Blatter 3796 !, Sedgwick 7597 ! 7670 !), below Third Tableland (McCann !); Londa (Woodrow ex Cooke).—*Deccan*: Talegaon (H.E.B.B. !).—*Konkan*: (Stocks, Law ex Cooke).—*S. M. Country*: Tadas, Dharwar Dist., 2,500 ft., rainfall 35 in. (Sedgwick 1909); Dharwar, in a marsh, 2,400 ft., rainfall 34 in. (Sedgwick 6613 !); Bidi, Belgaum Dist., 2,500 ft., rainfall 60 in. (Sedgwick 2976 !); Devarayi, 1,800 ft., rainfall 90 in. (Sedgwick 4476 !).—*N. Kanara*: (Woodrow ex Cooke); Haliyal (Talbot 2066 !); Kilgerry (Talbot 2615 !).

Flowering & fruiting: August 1914 (Talod); August 15th, 1891 (Kilgerry); September 1917 (Igatpuri, Bidi); September 27th, 1895 (Talegaon); October 1918 (Khandala, Devarayi); October 1920 (Panchgani); October 6th (Panchgani); October 10th, 1888 (Haliyal); November 1916 (Tadas); November 20th, 1889 (Haliyal).

Field notes: A plant of marshy soil. We have noticed that it usually grows in the shade of vegetation, protected from the morning sun.

Distribution: Endemic in the Bombay Presidency.

19. DIPLACRUM R. Br. (not in Cke.).

Small, tufted, glabrous, annual herbs. Stems leafy throughout. Spikelets very small in small, dense terminal and axillary clusters at the mouth of the leaf-sheaths, 1-sexual; male 3-4 at the base, 1-2-flowered with about 3 glumes, stamens 1-2; female terminal, 1-flowered with 2 opposite glumes. Style slender; stigmas 3. Nut globose or nearly so.—Species 3.—Tropics.

1. **Diplacrum caricinum** R. Br. Prodr. 241.—*Scleria caricina* Benth. Fl. Austral. vii, 426; C. B. Clarke in Hook. f. F.B.I. vi, 688.—*Ibidem* synonyms.

Description: Stems slender, 2.5-35 cm. high, clothed with the leaf-sheaths. Leaves linear, flat, 1.3-7.5 cm. long; bracts short, lanceolate, margins minutely scabrid. Clusters of spikelets small; spikelets minute, male 3-5 at the base, 1.25-1.5 cm. long, glumes 3-4, membranous or hyaline, brownish, female narrowly ovate; glumes 2, slightly united at the base and falling with the nut from the minute knobbed pedicel, coriaceous, ribbed, 1.75 cm. long, 3-cuspidate; lobes acuminate, midlobe longest, lateral lobes and part of the margins sometimes hyaline. Nut nearly globose, minutely apiculate, 1.25 mm. long, whitish or pale brown, strongly 15-ribbed, the ribs sometimes anastomosing.

Locality: *N. Kanara*: Siddhapur, grassland (Sedgwick 7019 !); Gersoppa Falls, on sand, 1,400 ft., rainfall 200 in. (Sedgwick 7147 !, Hallberg & McCann C25 !); Sirsi, grassland, 1,800 ft., rainfall 100 in. (Sedgwick 7001 !); to Sirsi (Hallberg & McCann C26 !); Sirsi to Siddhapur (Hallberg & McCann C28 !); Yellapur (Talbot 3 sheets !).

Flowering & fruiting: August 20th, 1884 (Yellapur); September 1884 (Yellapur); October 1919 (to Sirsi, Sirsi, Gersoppa Falls, Sirsi to Siddhapur, Siddhapur); October 25th, 1883 (Yellapur).

Distribution: From the Sikkim Terai and Assam to Ceylon and Tenasserim, N. Kanara.—Malaya, China, Australia.

WHERE BIG GAME 'TAKE THE WATERS'.[1]

A Hidden Watcher at a Burmese 'Salt-lick'.

BY

E. H. Peacock.

(*With* 3 *plates*).

There can be few places more likely to appeal to the lover of Nature than a secluded 'salt-lick' in some remote forest of Burma. Situated, generally, in a small clearing near some lonely forest stream, among rugged tree-clad hills these 'licks' are very often possessed of a charming scenic value besides being the haunt of a variety of wild animals and birds.

'Salt-licks' may take the form of earth banks or springs of water impregnated with mineral salts, sulphur springs, hot springs or those peculiar mud-volcanoes formed by the upheaval of decomposed volcanic rock by the pressure of gases escaping from below.

Ye-ngan, *sa-dwin*, *chit*, *chit-ngan*, the Burmese call these natural dispensaries from which the wild animals of the forest obtain the salts and sulphates that they know, instinctively, to be so beneficial to their health. So strong is this instinct and the amount of impregnated earth consumed so great that the animal droppings found near some of the 'dry-licks' are often composed almost wholly of mud.

The carnivora are only less eager than the deer, bison and *saing* to avail themselves of the tonic properties of the 'licks', and the trees surrounding well-situated 'wet-licks' in glades or clearings are often covered by flocks of green pigeons and other birds waiting for a safe moment in which to venture on to the ground and sip the waters of these healing springs.

Some natural law appears to protect the game at these 'licks' from ambuscade by the carnivora; at least I like to think so. I have never seen or heard of a 'kill' at, or very near, a 'salt-lick'. Men, however, are not to be so governed, and a 'lick' is generally the favourite resort of the poacher and, too frequently, some so-called sportsmen. The magnitude of the offence is appreciated and given expression to by the game laws; but surely such depravity deserves an even higher penalty than is generally imposed on the ordinary poacher.

When a 'salt-lick' is situated in very remote and secluded forests, wild animals will frequently emerge in the day-time. No more interesting scene for the work of the nature photographer can be imagined than a well-situated 'lick'.

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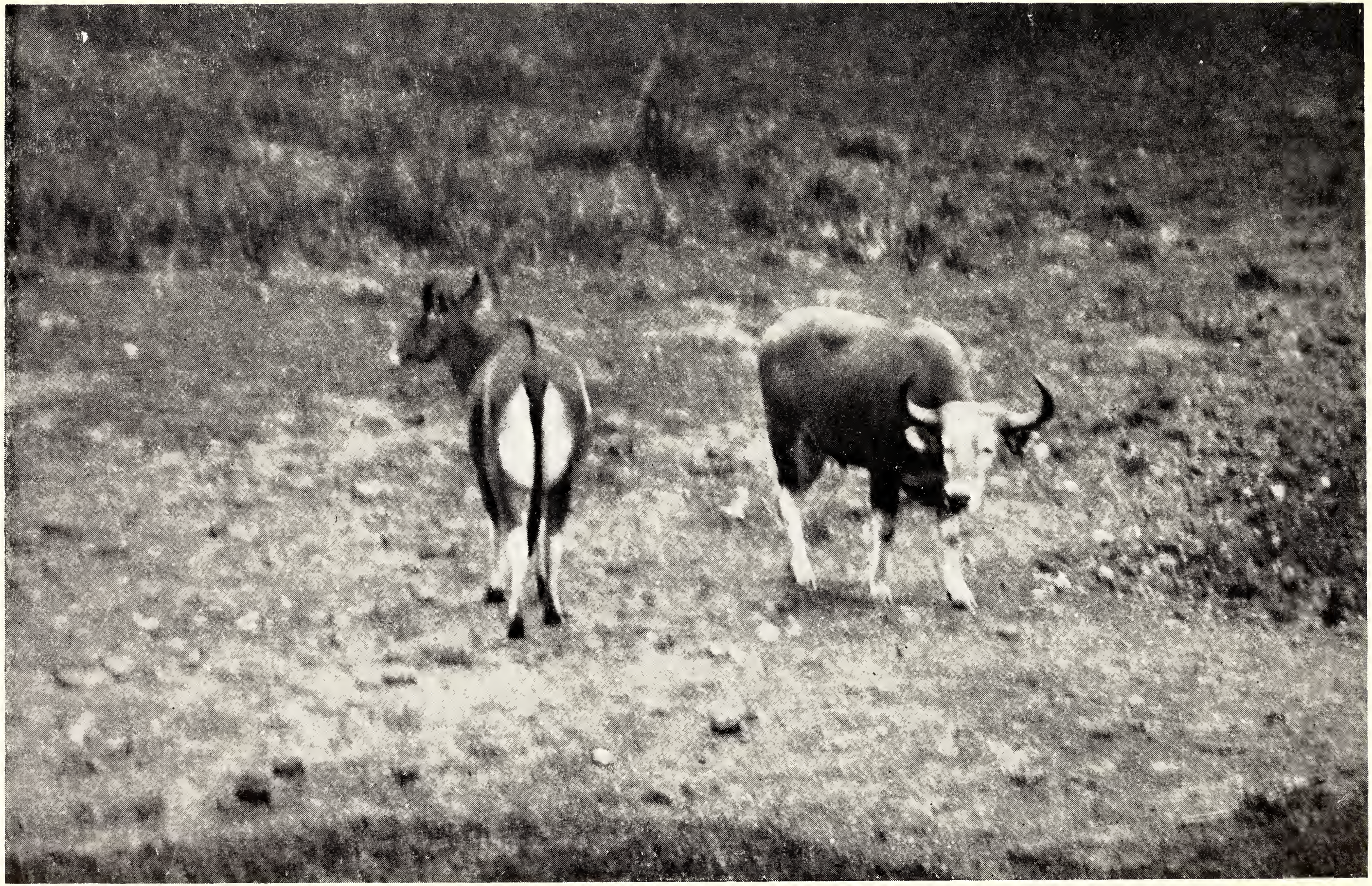
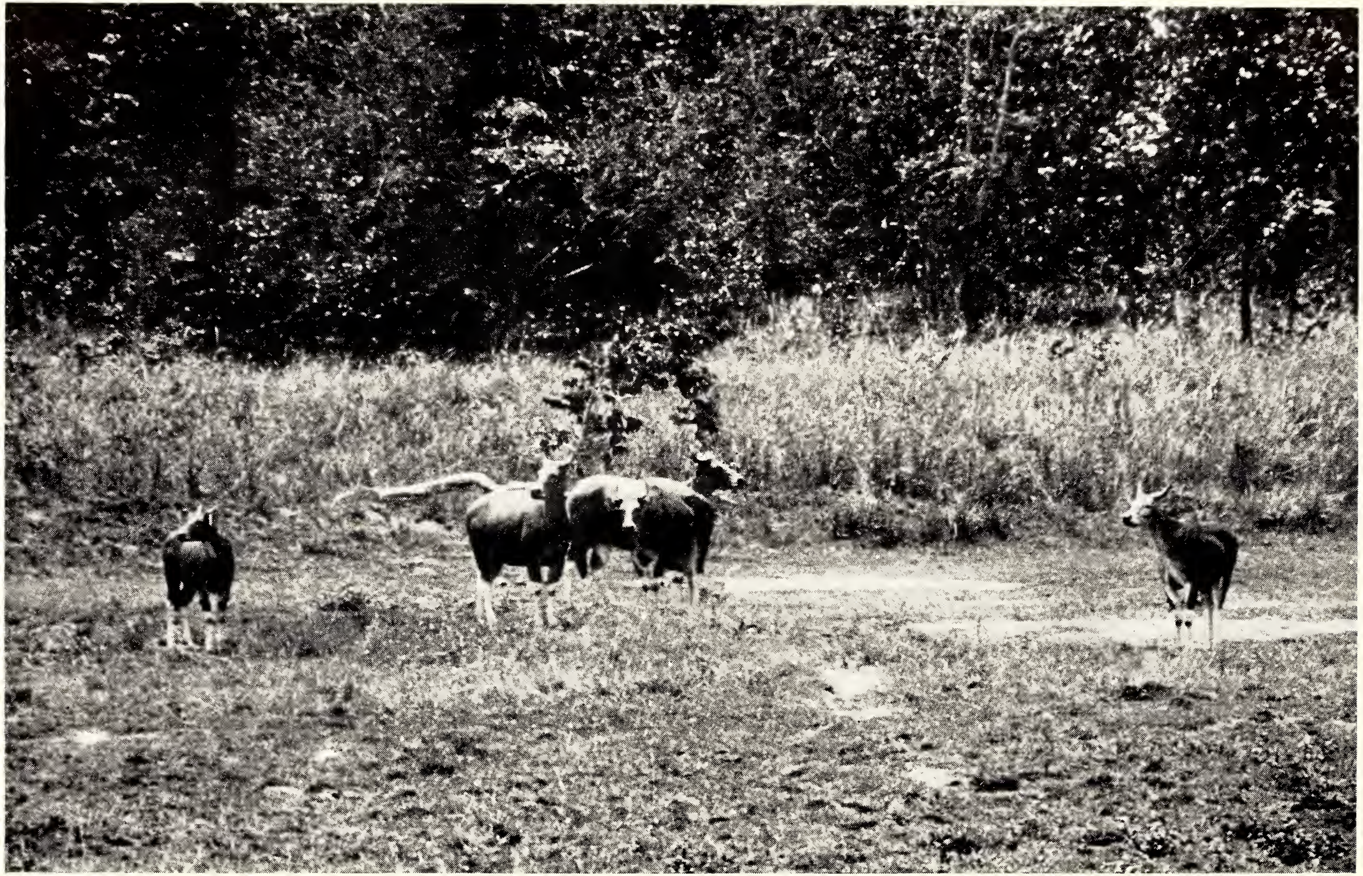
[1] By courtesy of *the Field*.



Copyright of E. H. Peacock.

A young bull and cow Saing (*Bibos banteng*, Lyd.) came embarrassingly close to our ' hide.'



Copyright of *E. H. Peacock.*

A herd of Saing (*B. banteng*, Lyd.) cows stood staring about them in perplexity and alarm.

Compared with the pastime of tracking or still-hunting for game, the practice of lying in wait with a camera near a 'salt-lick' is a comparatively sedentary sport; nevertheless, it is a delightful one and a welcome change from more strenuous pursuits.

There was a 'wet-lick' which we knew as the *Kason-chit* near which I had spent many fruitless hours in spite of the tracks indicating that it was frequently visited by bison, *saing*, sambur, hog-deer and barking-deer. On each occasion when I had watched over this 'lick', approaching game had crossed my tracks or an irritatingly changeable wind had made known my presence. Came a day, however, when Nature was kind and I obtained a mixed bag of photographs that recalls many pleasant memories.

The luck of this day was evident early in the morning as we were settling down to a five-mile tramp to the 'lick'. There had been rain during the night and the wet grass on the *lwins* was shimmering in waves of green and silver under the breath of the dawn-wind and a rising sun. It wanted some hours before the growing heat should bathe us in an uncomfortable bath of perspiration, and I found very little wrong with the world this pleasant morning. We followed a game path through a belt of woods and were about to cross a narrow *lwin* of short grass, when I spied a bison cow feeding near the skirts of the forest and, in the woods behind her, the dark shapes of a number of her companions.

The light had grown strong enough to dispense with a tripod and time exposures, so I made a quick stalk and, by good fortune, obtained a close photograph of this cow with her head down in the act of grazing. But some of the herd, which was on its way to its day-time lair in the forest, detected my presence and snorted. The cow near me promptly threw up her head and tail and turned to bolt. One more exposure I made while she was in this position and then they had all gone.

Feeling well pleased at this good start, I rejoined my men and, after still-hunting quietly through the intervening forests and *lwins*, we arrived at the *Kason-chit* before ten o'clock. Here we made a small 'hide' of leafy branches and, with a novel and a comfortable seat of leaves and grass, prepared to pass an enjoyable slack day.

I was engrossed in a thrilling drama of 'murder, mystery and love', when Maung Po Hte's rude tug at my sleeve brought me back to a world of facts.

'Daye'—hog-deer—he said, and stooped to look through a hole in the leafy wall of our hide.

An Elephant Pays a Call.

They were only two shy little hinds that walked mincingly to a pool of water on our left and, after many anxious glances around them, drank slowly. They would not cross the clearing and, after I had made a few long-range exposures, they walked quietly back into the long grass from which they had come.

When these hog-deer had gone, I went back into the world of Edgar Wallace; but it was not long before a loud crashing noise behind us brought me to my feet with the unpleasant conviction that a herd of wild elephants was close beside us. But it was only a young bull elephant that crashed carelessly down to the pool, got our wind and made an undignified retreat before ever I could get my camera aligned.

At mid-day we had food, and I tried to photograph the monkeys, hornbills and green pigeons perched on the trees upwind of our hide. Mostly I failed, but now and again I would make a few doubtful exposures.

The wanderer in these hills must carry away with him the memory of two sounds more frequently heard and insistent than others; the plaintive cooing of the green pigeons and the wonderfully clear, loud and varied scale of notes produced by the gibbons. White-browed in the north, white-handed in the south, these little tailless apes are ever within hearing, but most difficult to approach and photograph, unless one is prepared to give more time to their pursuit than is usually available. Yet there are few more attractive creatures to observe.

We had arranged to leave the 'lick' and still-hunt on the homeward route from about four or five o'clock in the evening; but it was very nearly four o'clock before any large game appeared at the 'lick'. I was becoming restless and tired of sitting still, when a slight noise on the opposite side of the clearing attracted my attention. I pressed my face close to a small gap in the leafy wall of our 'hide' and saw, to my delight, that a herd of *saing* had approached the 'lick' and that two or three cows had already walked out of the forest and into the clearing. A young bull and a cow *saing* came embarrassingly close to our 'hide'; the others spread themselves over the clearing and nibbled at the short grass at a range of about 40 to 60 yards. The wind was favourable, but, with two *saing* within 20 yards of our 'hide', I dared not make any but the gentlest movements.

I made two or three exposures on the young bull and cow near me, and was congratulating myself on this opportunity when some movement on my part, or instinct on theirs, warned the animals near me of my presence. They grew restless and walked off stiffly, their heads up and their eyes ready to catch the first sign of danger.

The alarm was communicated to the other members of the herd, which ran together and stood staring about them in perplexity and alarm. I made three or four exposures on this herd before they eventually made up their minds that something was definitely wrong and moved off into the woods.

I calculated that I had obtained one, if not two, good negatives of a bison cow, one of hog-deer and half a dozen of the *saing* herd —not to mention odds and ends of photos of birds and monkeys. I felt pleased and happy as we packed our few goods and left the 'hide' for our return journey.

I was carrying the camera, with tripod attached, over my arm and had just moved out of the 'hide' to one side of the clearing when I saw, within 20 yards, a sambur stag staring at me in wide-eyed horror. The surprise was mutual and, of course, before I could bring my camera to bear, he had gone like a wraith. What

Copyright of

A cow Bison (*B. gaurus*, H. Sm.) feeding near the skirts of the forest.

E. H. Peacock.

" She promptly threw up her head and tail and turned to bolt."

an opportunity to have lost! If only I had remained in the 'hide' for five more minutes he would probably have walked out into open view! These 'ifs'!

So home we went, feeling a bit depressed about that lost opportunity; hoping for something to occur which might soften the memory of that fine stag standing within 20 yards of us. And the hope was not altogether vain, for, just before the light began to fade, I saw three sambur hinds on a grass-covered knoll and made a close, though not entirely unobserved approach.

With them it was a case of tail up and ears up and: 'Who the devil are you?' a sharp stamping of feet, a resounding 'tit' and the clatter of hoofs as they bolted for the cover of the woods. And that was the last memory I hold of a day at the *Kason-chit;* but some photos remain, otherwise how shall 'the years which the locusts have eaten' be restored to us?

ON A COLLECTION OF FISH FROM AFGHANISTAN.

BY

SUNDER LAL HORA, D.SC., F.R.S.E., F.A.S.B.,

Assistant Superintendent, Zoological Survey of India, Calcutta.

(*With a plate and 4 text-figures*)

(Published with permission of the Director, Zoological Survey of India.)

In 1933, in the *Journal* of the Society an account was given of the fish of Afghanistan (vol. xxxvi, No. 3, pp. 688-706, 2 pls. and 2 text-figs.) and a small collection of five specimens was dealt with. During 1933, Sir Richard Maconachie, Major A. E. Farwell and Capt. E. W. Fletcher sent further material from Afghanistan to the Bombay Natural History Society which was kindly forwarded to me by Mr. S. H. Prater for examination and report. I am deeply indebted to these gentlemen for affording me an opportunity to report on a very valuable collection which has helped greatly in understanding the precise specific limits of a number of McClelland's hitherto ill-defined species from this country. Sufficient stress cannot be laid on the fact that, with the increased knowledge of the ichthyology of Afghanistan, the taxonomy and geographical distribution of the Central Asiatic fishes will become clear, and it will then be possible to standardise the classification of the fishes of this vast region.

The collection reported below was made at different places in all the three main river basins of Afghanistan: namely, those of the Kabul, the Helmand and the Oxus. At my request the collectors have supplied short ecological notes on the various localities in which the fish were collected and I propose to give below a list of these stations with the names of species collected therefrom.

KABUL SYSTEM.

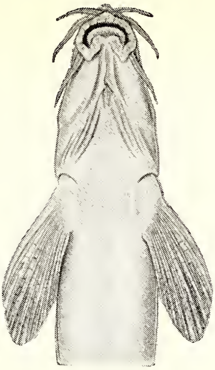
1. *Sar-i-Chashma.*—'The head springs of the Kabul river. Bottom stony, water clear and swift. Water cress and such like vegetation on the banks' (Major A. E. Farwell).

i. *Orcinus sinuatus* var. *griffithii* McClell.	1 specimen.
ii. *Nemachilus griffithii* var. *afghana*, nov.	4 specimens.

2. *Chahiltran stream.*—'A tributary of the Kabul river about 6 miles west of the Kabul City. The small stream has a pebbly bottom and has water cress and such like vegetation on its banks (Sir R. Maconachie).

i. *Nemachilus griffithii* var. *afghana*, nov.	1 specimen.

3. *Logar river.*—'Has a muddy bed and somewhat sluggish current. Runs through cultivation,—rice, wheat and barley predominating. No information as to where fish were caught, but believed to be in a pool' (Major A. E. Farwell). The Logar river is a tributary of the Kabul river; it arises in the Gul-Koh on the south



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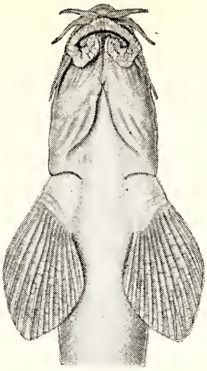

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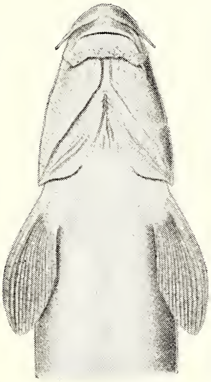

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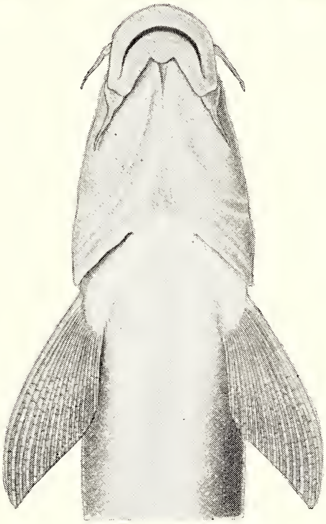

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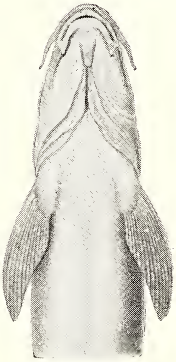

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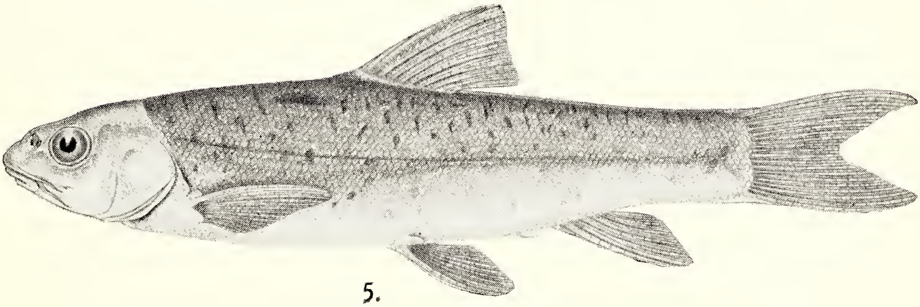

5.

FISHES OF AFGHANISTAN.

Fig. 1.—Ventral surface of head and anterior part of body of a young specimen of *Nemachilus* sp. prox. *griffithii* Günther. ×1 3/5.
Fig. 2.—Ventral surface of head and anterior part of body of the type-specimen of *Nemachilus farwelli*, sp. nov. Nat. size.
Fig. 3.—Ventral surface of head and anterior part of body of *Oreinus sinuatus* var. *griffithii* McClell. ×4/5.
Fig. 4.—Ventral surface of head and anterior part of body of *Schizothorax chrysochlora* (McClell.). ×4/5.
Fig. 5.—Lateral view of *Barbus capito conocephalus* × *Schizothorax* sp. ×1 1/5.
Fig. 6.—Ventral surface of head and anterior part of body of the above hybrid. ×1 1/5.

about 70 miles west of Kabul and joins the Kabul river about 10 miles below Kabul City. It has a length of about 200 miles and at its junction is as large as the Kabul river itself.

i. *Schizothorax intermedius* McClell.	2 specimens.
ii. *Schizothorax chrysochlora* (McClell.).	2 specimens.

Helmand System.

1. *Helmand river* (no definite locality is indicated).

i. *Nemachilus farwelli*, sp. nov.	1 specimen.

2. *Sar-i-Bulak stream.*—A tributary of the Helmand river 'approximately 100 miles due west of Kabul as the crow flies. Pebbly bottom, clear water, swift current. Little vegetation but barley and lucerne cultivation in places' (Major A. E. Farwell).

i. *Nemachilus* sp. prox. *griffithii* Günther.	17 specimens.

Oxus System.

1. *Darra Ashraf* and *Margh streams.*—'Mountain rivers on the north side of Hindukush. Rocky, stony bottoms, clear water and swift current. They join the Bamain river (there known as Surkhab) at Tala which is roughly 85 miles north-west of Kabul as the crow flies' (Major A. E. Farwell).

a. Darra Ashraf:—

i. *Salmo trutta aralensis oxianus* Kessler.	2 specimens.

b. Margh:—

i. *Salmo trutta aralensis oxianus* Kessler.	1 specimen.
ii. *Alburnoides bipunctatus* var. *eichwaldi* (Filippi).	1 specimen.

2. *Anderab river at Banu.*—The Anderab river 'rises on north-west side of Hindukush at Khawak Pass (35°40′ N., 69°45′ E.). Flows due west through Banu to Doshi (35°40′ N., 68°40′ E.) where it joins Surkhab which flows north into Oxus at about Kudukh Toba (37° N., 68°20′ E.). Bed rocky at Banu with a few deep pools. Current very rapid and water in July was very discoloured owing to irrigation of rice fields which line the banks. Willow fairly numerous along the banks, mulberry trees further inland. The two fish were taken in a small shallow backwater' (Capt. E. W. Fletcher).

i. *Glyptosternum reticulatum* McClell.	1 specimen.
ii. *Barbus capito conocephalus* × *Schizothorax* sp. (Hybrid).	1 specimen.

Capt. E. W. Fletcher has kindly supplied the following additional notes on the fish fauna of the Anderab river:—

'Local fishermen catch many "Chush"[1] in this stream with mulberries and they also catch trout[1] with slices of "Chush" on a hook. Twelve miles south of Banu lies the Arzu pass from which a small stream of the same name flows north to join the Anderab at Banu. This stream contains no "Chush" but is full of Oxus trout. About 6 miles from Banu it flows through a narrow gorge where there are many rocks. The current here is very swift and trout abound. In July 1933 trout were taken easily on locusts and averaged ½ to ¾ lb., running up to 1½ lb. Only one was taken on a fly. The vegetation consisted chiefly of grass and small scrub bushes, but rice cultivation and willow trees lined the banks up to about 3 miles north of Banu.

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[1] So far as my information goes, the local name 'Chush' or 'Choosh' is used in Kashmir for *Schizothorax micropogon* Heckel, though Heckel gave 'Ramghurdi' as its local name. *Sch. micropogon* is probably not found outside the Kashmir Valley, but it seems likely that in the name 'Chush' Capt. Fletcher makes a reference to a species of *Schizothorax*, of which, unfortunately, he did not collect a specimen. In the fishes collected by him from the Anderab river at Banu, there is a hybrid between a *Barbus* and a *Schizothorax* and it seems likely that both the genera are well represented in the Anderab river.

'At Khinjan (35°40′ N., 68°50′ E.) the Khinjan River flows into the Anderab from the south. This stream holds "Chush" certainly up to 3 miles from its junction with the Anderab. The vegetation consists chiefly of mulberry trees with some fields near the junction. Higher up, the banks are lined with small bushes and grass. About 14 miles from Khinjan trout were taken on fly in July. They averaged ½ lb. to ¾ lb. and ran up to 1½ lb. The stream was very swift and rocky. There were few locusts to be seen here and, in contradistinction to the Arzu stream, the trout would not look at them.'

It will be seen from the above that the collection dealt with here comprises only 34 specimens belonging to nine species or varieties and a hybrid form. Through the kindness of Dr. C. Tate Regan and Mr. J. R. Norman, a type-specimen of *Nemachilus griffithii* was sent to me for study and I have availed myself of this opportunity to add a few further notes on the species and to give a drawing of the specimen. The specimens from the Paghman river described under this specific name in 1933, as well as those obtained at Sar-i-Chashma and in the Chahiltran stream as noted above, are separated into a new variety *afghana* of *N. griffithii*. A very characteristic new species of *Nemachilus* is described from the Helmand river. *Schizothorax chrysochlora* (McClelland) is described in detail for the first time, and the probable specific limits of *Sch. intermedius* McClelland are indicated. *Oreinus sinuatus* var. *griffithii*, *Alburnoides bipunctatus* var. *eichwaldi*, *Salmo trutta aralensis oxianus*, and *Glyptosternum reticulatum* are recorded from new localities. A full description of a hybrid form between a *Barbus* and a *Schizothorax* is given.

Through the generosity of the Bombay Natural History Society it has been possible to illustrate the paper adequately, and I have great pleasure in offering my sincerest thanks to Mr. S. H. Prater for his kind interest. Mr. R. Bagchi has delineated the fishes under my supervision with his usual skill and care, and my best thanks are due to him for this.

The material is preserved in the collection of the Zoological Survey of India, with the exception of a few specimens of loaches sent to the British Museum (Natural History). The types are deposited in the Indian Museum.

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[1] The commonest trout in these parts is *Salmo trutta aralensis oxianus* Kessler.

Salmo trutta aralensis oxianus Kessler.

1842. *Salmo orientalis*, McClelland (*nec* Pallas), *Calcutta Journ. Nat. Hist.* ii, 585.

1843. *Salmo orientalis*, McClelland (*nec* Pallas), *Calcutta Journ. Nat. Hist.* iii, pp. 283-287.

1874. *Salmo oxianus*, Kessler, 'Pisces' in Fedtschenko's *Reise in Turkestan*, p. 35.

1932. *Salmo trutta aralensis* Berg morpha *fario* L., Berg. *Poiss. Eaux Douces de l' U.R.S.S. et des Pays Limitrophes* 3rd. Edition, i, p. 161 (See earlier references).

1933. *The Bamean Trout*, Hora, *Journ. Bombay Nat. Hist. Soc.* xxxvi, pp. 700-705, pl.-figs. 3 & 4, 2 text-figs.

In the recent collection of fish from Afghanistan, there are 3 specimens of the Bamean Trout, the largest is about 150 mm. in total length. Two of these were caught in the Darra Ashraf and one in the Margh stream. These two streams are 4 miles apart and run into the Surkhab river (Bamean river) which is a tributary of the Oxus.

Through the kindness of Prof. L. Berg, the Zoological Survey of India now possesses one of the typical specimens of *Salmo oxianus* Kessler (No. 2840 of the Zoological Museum at Leningrad). It is 208 mm. in total length and is in a very good state of preservation. It was obtained from 'Kyzyl-su river, Basin of the Upper Amu-darya, Alai Valley, Pamir'. A comparison between this and the Afghanistan specimen has shown that they are absolutely identical with the exception of such characters which are liable to vary with the length of the individuals.

The specimens from Afghanistan are in the Parr state and possess the characteristic colouration.

The vernacular name of the trout is *Māhī-i-Khāldār* which literally means 'a fish with spots'. I am informed that in standard Persian it is called *māhī-i-qizil-ālā* 'the red-speckled fish' and in the Turkish-speaking provinces of Persia *āla-bāliq* 'the spotted fish'. The Afghan name (not Kabuli but Persian) is, in view of the characteristic colouration, very appropriate.

Glyptosternum reticulatum McClelland.

1933. *Glyptosternum reticulatum*, Hora, *Journ. Bombay Nat. Hist. Soc.* xxxvi, p. 697 (see for earlier references).

A fine specimen of *Glyptosternum reticulatum*, 196 mm. in total length, was collected by Capt. E. W. Fletcher from the Banu Andrab river, about 79 miles north of Kabul at an altitude of 4,300 ft. The entire dorsal and lateral surfaces of the fish are reticulated with blackish spots and markings, and it is likely that such a colour-pattern may have been responsible for the specific name *reticulatum*. The caudal fin and the distal half of the anal fin are more deeply pigmented. The ventral surface in front of the ventral fins is roughened by small and hard papillae. The adipose dorsal is well developed, it is as long as the tail portion of the body without the caudal fin and its height is equal to half the width of the mouth.

In the group of the Sisorid fishes to which *Glyptosternum* belongs, a new genus—*Oreoglanis*—has been described recently by Smith.[1] To indicate the relationship of this genus, he has given a key to the genera of Glyptosternoid cat-fishes. Moreover, he has indicated that, as already pointed out by me,[2] *Parexostoma* Regan is synonymous with *Glyptosternum* McClelland.

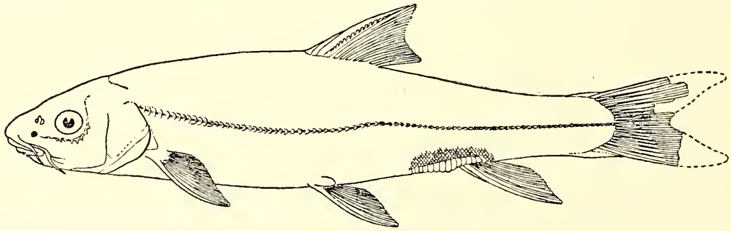
G. reticulatum has recently been found at two different places within the limits of Afghanistan.

Schizothorax intermedius McClelland.

1842. *Schizothorax intermedius*, McClelland, *Calcutta Journ. Nat. Hist.* ii, p. 579.

1868. *Schizothorax intermedius*, Günther, *Cat. Fish. Brit. Mus.* vii, p. 165.

In grouping species of *Schizothorax*, McClelland included *Sch. intermedius* and *Sch. esocinus* among those forms in which the lower lip presents 'a free reflected margin only at the angles of the mouth'. Besides this character, there is no other indication in the description of the former species by which it could be distinguished from the allied forms. Unfortunately McClelland did not publish any drawing of the species, so its determination would have always remained a guess-work had McClelland not sent 3 specimens of the species to the 'Museum at the India House', whence two examples (stuffed, 11 in. long and skin, 9 in. long) passed to the collection at the British Museum and served for the description of the species by Günther in his *Catalogue of Fishes*. I have no doubt that Günther had before him the typical specimens of the species. In the collection of fish from Afghanistan, there are two specimens—badly preserved and somewhat damaged—which agree very closely with Günther's description of *Sch. intermedius*. These were collected in the Logar river, a tributary of the Kabul river, to the south of Kabul. It is significant that the original specimens of the species were collected by Griffith in the Kabul river at Jallalabad and in the Tarnuck river.



Text-fig. 1.—Lateral view of *Schizothorax intermedius* McClelland. × ½.

From Günther's description of *Sch. intermedius* and from an examination of specimens before me, the following salient characters of the species may be mentioned:—

(i) Lower labial fold interrupted in the middle.

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[1] Smith, *Journ. Siam Soc., Nat. Hist. Suppl.* ix, pp. 70-74, pl. iii, 1 text-fig. (1933).

[2] Hora, *Ann. Mag. Nat. Hist.* (10) x, pp. 176-179 (1932); *Cur. Sci.* i, p. 130 (1932).

(ii) Commencement of dorsal fin nearly midway between the tip of the snout and the base of the caudal fin.
(iii) Eyes situated not entirely in the anterior half of the head.
(iv) Anal scales not much developed, the largest being scarcely half as broad as the orbit.
(v) Height of head at occiput considerably greater than its width.
(vi) Body without spots.

A perusal of the literature shows that a very wide interpretation has been given to *Sch. intermedius* and that several unrelated forms have been designated by this title. The confusion seems to have been started by Day,[1] who, in 1876 and 1878, described and figured specimens from Kashgar, Yangihissar and Sirikol as *Sch. intermedius*. I have examined some of these specimens in the collection of the Indian Museum, and find that in all of them the eye is situated entirely in the anterior half of the head, and that the anal scales are relatively larger. The dorsal spine is stronger and more coarsely serrated, and the scales are relatively much larger in size. Herzenstein[2] relegated *Sch. aksaiensis* Kessler and *Sch. affinis* Kessler to the rank of the subspecies of *Sch. intermedius* and described *malacorrhynchus* as a new subspecies. Berg[3] in his latest work has given a comprehensive scheme of classification of the various subspecies of *Sch. intermedius*. I am unable to agree to the system proposed by Berg, and in the absence of sufficient material of the Central Asiatic forms associated with McClelland's species, I am unable to define the specific limits of these forms. In order to facilitate reference, I give below a table of measurements of the two specimens, but it has to be understood that, due to the damaged condition and poor preservation of the specimens, some of the measurements are likely to be faulty.

Measurements in millimetres

Total length without caudal	96·0	156·0
Length of head	25·0	38·0
Height of head	15·2	25·8
Width of head	13·3	22·2
Length of snout	9·0	13·8
Diameter of eye	6·8	6·7
Interorbital width	7·8	13·5
Depth of body	18·5	30·0
Longest ray of dorsal	19·0	28·0
Longest ray of anal	16·5	26·8
Length of pectoral	19·8	28·0
Length of ventral	17·3	25·4
Length of caudal peduncle	17·3	27·0
Least height of caudal peduncle	8·5	14·5

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[1] Day, *Proc. Zool. Soc. London*, p. 786 (1876); Ichthyology, *Sci. Res. 2nd Yarkand Miss.*, p. 5 (1878).

[2] Herzenstein, 'Fische', in *Wiss Res. Przewalski Central As. Reis. Zool. Theil*, iii (2), pp. 106-117 (1889).

[3] Berg, *Poissons des Eaux Douces de l' U.R.S.S.*, i, pp. 458-462 (1932). See earlier references.

Local name:—The two specimens of *Sch. intermedius* were sent with the two specimens of the following species under the common name *Sheer-Māhi*.

Schizothorax chrysochlora McClelland.

(Pl.-fig. 4; text-fig. 2.)

1842. *Racoma chrysochlora*, McClelland, *Calcutta Journ. Nat. Hist. Soc.* ii, p. 577, pl. xv, fig. 2.

Schizothorax chrysochlora was described by McClelland from Mr. Griffith's notes and the figure is stated to have been 'reduced from his very excellent drawing'. The diagnosis of the species is very poor and of a generalized nature. It reads as 'Mouth directed forward, intermaxillaries protractile, without spots, scales small, raised on the lateral line, vertical anal scales large, colour brownish yellow, operculum square behind, intestine convoluted in a conical form in the anterior part of the abdomen, and equal to six lengths of the body'. *Sch. chrysochlora* is stated to grow to a length of 10 inches and was collected in the Kabul river at Lalpore. At Lalpore, Mr. Griffith 'procured a fish I believe identical with the nepoora of Assam, *C. falcatus* of Hardwicke, a Barbus, a Gonorhynchus, a small Mahasir, and a remarkable fish, which appears to me the type of *types* of Carnivorous *Poeonominae*'. It would thus appear that *Sch. chrysochlora* was obtained from the lower region of the Kabul river where there is a mixture of the Indian and Central Asiatic species of fishes. Under the description of *Racoma labiatus*, McClelland says: 'Mr. Griffith remarks that this singular form is nearly allied to the Lalpore species, but that the intestines of the latter are infinitely longer, nor is there any enlargement of the lips in the latter; but this last character Mr. Griffith remarks is not so remarkable in young specimens'. It is this indication of a close similarity between *labiatus* and *chrysochlora* that has helped me in assigning two badly preserved and damaged specimens from the Logar river, a tributary of the Kabul river, to *Sch. chrysochlora*. *Sch. labiatus* is the commonest species in the Chitral Valley, whence my colleague, Dr. B. N. Chopra, obtained a large series of nicely preserved specimens. This material has proved very useful in studying the form referred to as *Sch. chrysochlora* by McClelland.

In 1876, Day[1] described and two years later figured certain specimens collected by the Second Yarkand Mission at 'Kashghar, Yangihissar, and Yarkand' as *Sch. chrysochlorus*. In the collection of the Zoological Survey of India, there are several specimens purchased from Day and labelled as *Sch. chrysochlorus*. In these specimens the eye is entirely in the anterior half of the head, which is low and elongate. The snout is also very long and the fold of the lower lip does not extend beyond the symphysis. The anal scales are but little developed. In McClelland's *Sch. chrysochlora* the vertical anal scales are large and the fold of the lower lip is free throughout and somewhat trilobate as in *Sch. labiatus*. It would thus appear that Day's identification of the Yarkand Mission specimens as *Sch. chrysochlora* was not correct and that they in reality belong to *Sch. biddulphi* Günther.[1]

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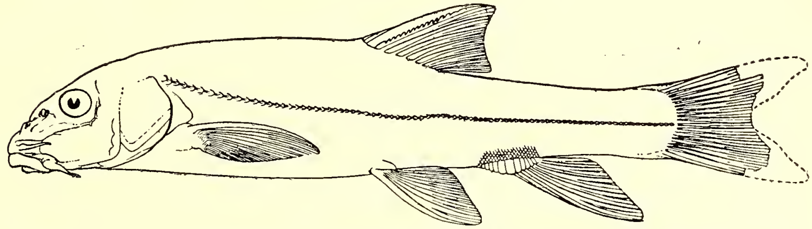
[1] Day, *Proc. Zool. Soc. London*, p. 784 (1876); *Sci. Res. 2nd Yarkand Miss.*, Ichthyology, p. 3, pl. i, fig. 2 (1878).

It would thus appear that since its discovery, *Sch. chrysochlora* has remained unknown and that both the description and figure of it by McClelland have not proved sufficient for elucidating its precise specific limits. Günther[2] included it among other ill-defined species of *Schizothorax*, and in 1889[3] doubted the use of the name by Day for a species from Yarkand. This point was elaborated by Herzenstein[4] who showed that Day was not justified in applying McClelland's name *Sch. chrysochlora* to a species so different from McClelland's original form.

From McClelland's original description and figure of *Sch. chrysochlora*, the following salient features may be noted, though the description is certainly very meagre and applicable 'to more than one species of *Schizothorax*' as remarked by Günther.

(i) Body without spots.
(ii) 'Scales small, raised on the lateral line, *vertical anal scales large*' (italics are mine).
(iii) The head is short and high.
(iv) The eye is situated almost in the middle of the length of the head.
(v) The species is found in the lower reaches of the Kabul river where certain species of the Indian fauna are also found.

The two specimens before me agree in all these points with McClelland's description, but unfortunately they are not in a good state of preservation and, therefore, a detailed description cannot be given. Attention may, however, be directed to some of the salient features to facilitate reference in future.



Text.-fig. 2.—Lateral view of *Schizothorax chrysochlora* (McClelland). × $\frac{1}{2}$.

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[1] Günther, *Ann. Mag. Nat. Hist.* (4), xvii, p. 400 (1876).

Schizothorax biddulphi was described by Günther from two skins, the larger being 15.5 in. long. In Day's specimens and description of *Sch. chrysochlorus* the length of the head is about $4\frac{3}{4}$ to $5\frac{1}{3}$ in the total length, but Günther says 'one-fifth of the total (without caudal)'. Günther usually excluded the caudal fin in giving the total length, but in this case I believe he meant to say 'with caudal'. In all other respects Day's *Sch. chrysochlorus* and Günther's *Sch. biddulphi* appear to be almost identical.

[2] Günther, *Cat. Fish. Brit. Mus.*, vii, p. 162 (1868).

[3] Günther, *Trans. Linn. Soc. London* (2), v, p. 107 (1889).

[4] Herzenstein, 'Fische', in *Wiss. Res. Przewalski Central Asi. Reis. Zool. Theil*, iii (2), pp. 154-156 (1889).

D. 3/8; A. 3/5; P. 20; V. 10.

The dorsal profile rises abruptly from the tip of the snout to the nape and then gently to the base of the dorsal fin beyond which it slopes down to the base of the caudal fin. The ventral profile in front of the anal fin is almost straight or only slightly arched. The ventral surface of the head and the anterior part of the body is somewhat flattened. In the larger specimen, the maxillaries are protruded and the length of the head cannot be ascertained accurately. The length of the head is contained from 3·5 to 3·7 times in the total length without the caudal. The width of the head is contained 1·7 to 1·8 times and the height of the head 1·6 to 1·7 times in its length. The eye is dorso-lateral in position and is barely visible from the ventral surface; in the smaller specimen it is situated considerably nearer to the tip of the snout than to the posterior margin of the operculum, but in the larger specimen the eye is almost in the middle of the length of the head. The diameter of the eye is contained 4·7 to 5·0 times in the length of the head, 1·5 to 2·3 times in the length of the snout and 1·2 to 1·6 times in the interorbital width. These proportions indicate that the eyes undergo considerable variation both in size and position with the growth of the fish. The interorbital space is broad and flattened. The mouth is subterminal, transverse and arched; it is bordered by thick lips which are continuous all round the mouth so that the reflected posterior margin of the lower lip is entire. In the larger specimen, this labial fold is trilobed. The edge of the lower jaw is sharp and strong, and is covered with a horny covering. The barbels are subequal and longer than the diameter of the eye. The depth of the body is contained 5·2 times in the total length without the caudal. The scales are small, but those on the lateral line are somewhat larger and raised. There are several transverse rows of larger scales behind the gill-opening, and the anal scales are almost as long as half the diameter of the eye. The ventral surface between the pectorals is devoid of scales. The lateral line is complete and runs to the middle of the base of the caudal fin.

The dorsal fin arises slightly in advance of the ventrals and its commencement is considerably nearer the base of caudal than the tip of the snout. The last dorsal spine is bony, but quite flexible in the distal one-third of its length, and is serrated along the posterior border. The longest ray of the dorsal fin is shorter than the depth of the body. The pectoral, ventral and anal fins are long and pointed, but none of these fins, when laid flat, reaches the one following it. The caudal fin is damaged in both the specimens, but McClelland's figure shows it to be a deeply bifurcate structure. The anal opening is situated just before the anal fin. There is an adnate scaly appendage in the axil of the ventral fin. The caudal peduncle is about 1·7 to 1·9 times as long as its least height.

The colour is greyish above the lateral line, pale-olivaceous below it and much lighter on the ventral surface.

Remarks.—As remarked by Griffith, *Sch. chrysochlora* has much in common with *Sch. labiatus* McClelland, and especially with those specimens of the latter in which the labial fold is not well-developed. I have dealt with the variation exhibited by *Sch. labiatus* in my report on the Chitral Fishes published in the *Records of the Indian Museum.* I have compared the larger specimen of *Sch. chrysochlora* with a specimen of the same size of *Sch. labiatus* with the following results:—

In *Sch. labiatus* the body is more slender and the head is considerably pointed; the labial fold is well-developed and prominently trilobed, the commencement of the dorsal fin is almost midway between the tip of the snout and the base of the caudal fin, and the anal scales are very small, considerably less than half the diameter of the eye. It is thus seen that the two species can be readily distinguished from each other.

Measurements in millimetres.[1]

Total length without caudal	94·5	177·0
Length of head	26·3	47·0
Height of head	15·0	29·6
Width of head	14·2	26·5
Length of snout	9·5	21·0
Diameter of eye	5·6	9·3
Interorbital distance	6·7	15·3
Depth of body	18·0	34·0
Longest ray of dorsal	17·4	32·0
Longest ray of anal	15·7	31·0
Length of pectoral...	18·2	34·3
Length of ventral	15·0	32·0
Length of caudal peduncle	16·0	30·8
Least height of caudal peduncle	9·0	16·0

Local name.—*Sch. chrysochlora* is locally known as *Sheer Māhī*, which literally means milk-fish or sweet-fish. It seems to be a common name for species of *Schizothorax* in Afghanistan, and in this reference is made probably to the taste of the flesh of these fishes.

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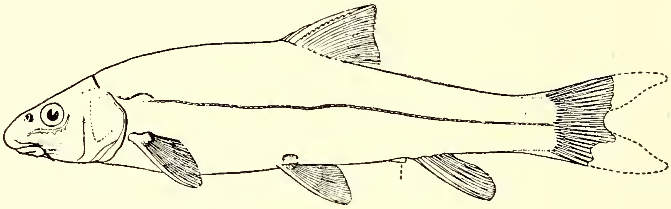
[1] On account of the protruded condition of the upper jaw and poor condition of preservation of the specimens, the measurements are likely to be faulty in certain cases, and should, therefore, be taken with considerable reserve.

Oreinus sinuatus var. **griffithii** McClelland

(Plate-fig. 3; text-fig. 3.)

1933. *Oreinus sinuatus* var. *griffithii*, Hora, *Journ. Bombay Nat. Hist. Soc.* xxxvi, p. 700.

In the collections of fish made in Afghanistan during 1933, there is a single specimen of the genus *Oreinus*, which I refer to *O. sinuatus* var. *griffithii*. The specimen was collected by Major A. E. Farwell at Sar-i-Chashma, the source of the Kabul river; it is 136·5 mm. in length without the caudal and is in a fine state of preservation. In my article[1] on the fish of Afghanistan, reasons were given for regarding the Kabul river form as distinct from *O. sinuatus*, though both are very much alike superficially. I have described this form in detail in my account of the fish of Chitral which will be published in the *Records of the Indian Museum*.



Text-fig. 3.—Lateral view of *Oreinus sinuatus* var. *griffithii* McClelland.

The following note from Griffith's observations is of special significance. Writing of the fish fauna of the Kabul river, he says: 'Towards its origin, and throughout the upper part of the Mydan Valley, a species of Oreinus is very abundant, numbers may be taken with a worm, the only instance I know of a fish with a Gonorhynchoid mouth taking bait. This same species swarms in the fine springs (from limestone) at Sar-i-Chashmah, which are the main source of the river; the fish are considered sacred, and appear to eat anything presented to them; the size does not exceed 5 lbs.'[2]

Alburnoides bipunctatus var. **eichwaldi** (Filippi).

1932. *Alburnoides bipunctatus eichwaldi*, Berg, *Poiss. des Eaux Douces U.R.S.S.*, i, p. 493 (see synonyms).

There is a single specimen, 74 mm. in length without the caudal, which I assign to *Alburnoides bipunctatus* var. *eichwaldi*. It was collected from the Margh river, a tributary of the Surkhab river. It has alrealy been indicated[3] that this is one of the species commonly found in the Upper Amudaria.

The fish is locally known as *Māhī putrā*.

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[1] Hora, *Journ. Bombay Nat. Hist. Soc.*, xxxvi, p. 700 (1933).

[2] Griffith, *Calcutta Journ. Nat. Hist. Soc.*, ii, p. 564 (1842).

[3] Hora, *Journ. Bombay Nat. Hist. Soc.*, xxxvi, p. 706 (1933).

Barbus capito conocephalus Kessler × **Schizothorax** sp.

(Plate-figs. 5 & 6.)

In the small collection made by Capt. E. W. Fletcher in July 1933 from the Banu Anderab river, there is a small fish, 95 mm. in total length, which appears to be a hybrid between *Barbus capito conocephalus* and some species of *Schizothorax.* In general facies, it resembles the fishes of the subfamily *Schizothoracinae*, but possesses relatively larger scales. The lower jaw is bare anteriorly and the lip is somewhat papillated, so that the ventral surface of the head gives the appearance of a young *Orcinus.* A somewhat similar hybrid—*Barbus capito conocephalus* × *Schizothorax pseudaksaiensis issykkuli*—has been figured by Berg,[1] but, as compared with it, the head in the specimen under report is relatively short, high and much more rounded anteriorly. From the build of its head, it seems likely that the Afghanistan specimen is the result of crossing of the species of *Barbus* referred to above and *Schizothorax irregularis* (Berg, *Sch. intermedius irregularis*, *l.c.*, p. 460, fig. 385), but in the absence of sufficient material, it is not possible to be dogmatic about this suggestion. The interesting specimen is, however, described and figured here for future reference.

D. 3/8; A. 2/5; P. 15; V. 9; C. 20, besides smaller rays at the sides.

The specimen is subcylindrical with a short and rounded head. The ventral surface of the head is somewhat flattish and both the profiles are only slightly arched. The length of the head, of the caudal fin and the depth of the body are equal and are contained 5 times in the total length and 4 times in the length without the caudal. The width of the head is contained 1·6 times and the height of the head at the occiput 1·4 times in the length of the head. The eyes are large, dorso-lateral in position and hardly visible from the ventral surface; they are mostly situated in the anterior half of the head. The diameter of the eye is contained 3·8 times in the length of the head and 1·2 times in the length of the snout and the interorbital width. The nostrils are situated near the anterio-superior border of the eye. The mouth is transverse, semicircular and inferior; it is bordered by flat lips which are continuous at the angles of the mouth; the labial fold is interrupted in the middle; the flat, lower lip is finely papillated. The distal portion of the upper jaw is vertical and, when the mouth is closed, it lies in front of the lower jaw, which is hard, sharp and shovel-shaped for rasping purposes. A portion of the lower jaw is not covered by the lip anteriorly. There are two pairs of well-developed barbels, both longer than the diameter of the eye.

The base of the dorsal fin is midway between the anterior border of the eye and the base of the caudal fin; its longest ray is not as high as the depth of the body below it. The last spine is bony, but weak, and strongly denticulated posteriorly; there are about a dozen pair of teeth along the posterior border. The dorsal fin commences considerably in advance of the ventrals. The pectoral fins are long and pointed, but do not extend as far as the base of the ventrals, which are similar to the pectorals and do not reach the anal-opening. The anal fin, when adpressed, does not reach the base of the caudal fin. The caudal fin is deeply forked and the lobes are sharp and pointed; the upper lobe is slightly longer than the lower. The caudal peduncle is 1·4 times as long as its least height.

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[1] Berg, *Poisson des Eaux Douces U.R.S.S.*, 3rd ed., i, p. 450 (Leningrad: 1932).

The lateral line is complete and runs to the middle of the base of the caudal fin. The scales are small and imbricate. There are about 82 rows of scales in a longitudinal series, 14 between the lateral line and the commencement of the dorsal and 11 rows between the lateral line and the base of the ventral. There is a fleshy appendage in the axil of the pectoral fin, but none above the base of the ventral fin. The anal-opening and the anterior part of the base of the anal fin are provided with rows of somewhat larger scales. On the ventral surface the scales are embedded in the skin and there are only faint indications externally.

The colour is grayish above and pale-olivaceous below. The sides are marked with small, irregular patches of black colour which usually characterize the young *Schizothoracinae*.

Measurements in millimetres.

Total length including caudal	95·0
Length of caudal	19·0
Depth of body	19·0
Length of head	19·0
Width of head	11·8
Height of head at occiput	13·5
Length of snout	6·0
Diameter of eye	5·0
Interorbital width	6·0
Longest ray of dorsal	16·0
Longest ray of anal	13·0
Length of pectoral	16·0
Length of ventral	13·3
Length of caudal peduncle	14·0
Least height of caudal peduncle	9·8

GENUS: **Nemachilus** van Hasselt.

(Plate-figs. 1 & 2; text-fig. 4.)

The species of the genus *Nemachilus* are so numerous and the characters by which they are usually differentiated are so variable that considerable difficulty has often been experienced in separating one form from the other. This is specially so in the case of related species. The Nemachili from Afghanistan have hitherto proved to be a very confusing lot, but an attempt is made here to elucidate the precise limits of the various forms.

In 1929[1] attention was directed to the type material of two loaches from Afghanistan in the collection of the British Museum which had been erroneously stated to have come from 'Bhoutan' and 'Assam' in Günther's *Catalogue*.[2] Short notes were published then on the type specimens of *Adiposia boutanensis* (McClell.) and *Nemachilus griffithii* Günther, and their probable affinities were discussed. It was further stated that the former species was probably obtained in the Helmand basin near the Bolan Pass and the latter from the Arghandab river near Candahar. In 1933,[3] I assigned two specimens collected in the Paghman river, a tributary of the Kabul river near Kabul, to *N. griffithii* and published a detailed account with figures. It was indicated that the Paghman specimens differed from the typical examples in several important respects, but on account of the paucity of the material and the much smaller size of the fresh specimens, it was not considered advisable to propose a new name for them. In the collection under report, there are 23 specimens of the genus *Nemachilus*, 18 from the Helmand river basin and 5 from the Kabul river basin. Of the Kabul river specimens, 4 were obtained in the spring at Sar-i-Chashma and 1 in the Chahiltran stream; and these (text-fig. 4*c*) correspond in every respect with the specimens already reported from the Paghman river. It may be recalled that Griffith[4] observed a loach very common in the small channels by which the springs at Sar-i-Chashma run off. It is thus clear that in the Kabul river and its tributary streams, at least in the neighbourhood of Kabul, this particular type of loach is common, and as it differs in certain particulars from *N. griffithii*, I propose to treat it here as a separate variety which may be designated as **afghana.**

Through the kindness of Dr. C. Tate Regan and Mr. J. R. Norman, I have received on loan one of the two typical specimens of *N. griffithii* from the British Museum (Natural History). In forwarding the specimens Mr. Norman has observed that it 'differs somewhat from the other type in having a generally shorter and thicker body, shorter and less slender caudal peduncle and a rather larger head. We have little doubt, however, that in spite of these differences, the two types represent the same species'. The specimen (text-fig. 4*a*), which I have studied, is not in a good state of preservation, and is too flabby for accurate measurements. So far as it can be ascertained the length of the head is contained 4·7 times in the total length without the caudal, and the commencement of the dorsal fin is nearer to the base of the caudal than to the tip of the snout. The distance between the pectoral and the ventral fins is about equal to the length of the pectoral. The least height of the caudal peduncle is contained 2·5 times in its length. The caudal peduncle is muscular but is not much compressed from side to side. The diameter of the eye is contained 7·5 times in the length of the head, 3 times in the length of the snout and 1·5 times in the interorbital width. The snout is shorter than the postorbital part of the head. On comparing the above notes with the description of the species by Günther, two conclusions seem to be justified, (1) that Günther probably used the longer and narrower specimen for drawing up his description and (2) the species is subject to considerable vari-

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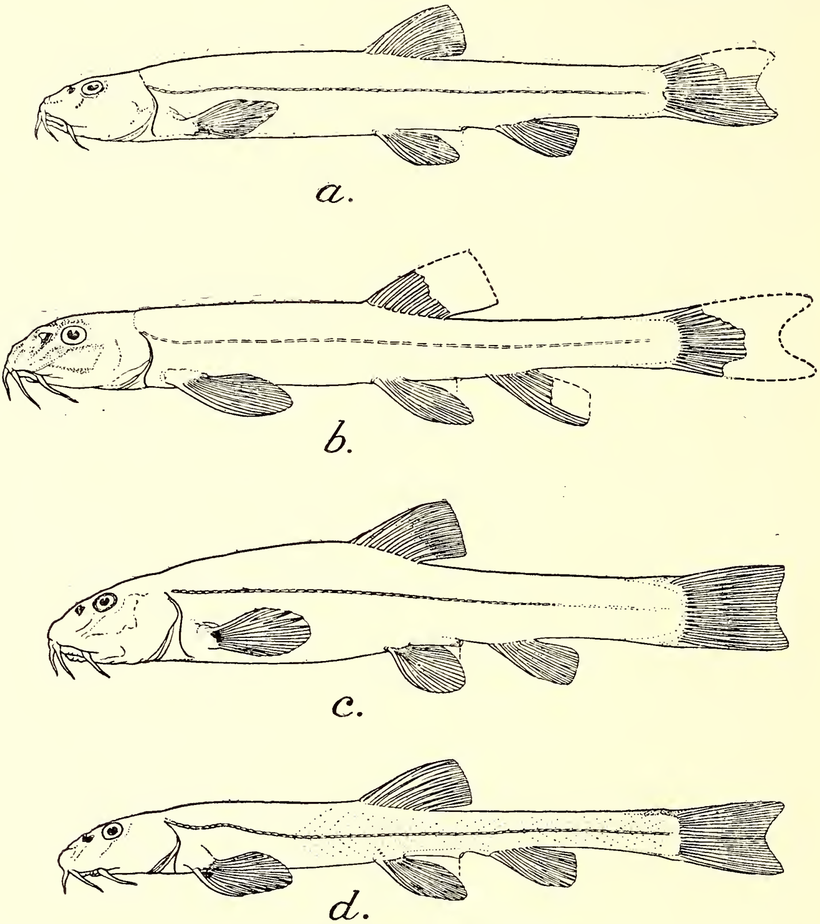
[1] Hora, *Journ. Proc. As. Soc. Bengal* (n.s.), xxiv, pp. 481-484, 1928 (1929).

[2] Günther, *Cat. Fish. Brit. Mus.*, vii, pp. 358, 360 (1868).

[3] Hora, *Journ. Bombay Nat. Hist. Soc.*, xxxvi, pp. 697-699, pl.-figs. 1 & 2 (1933).

[4] Griffith, *Calcutta Journ. Nat. Hist.*, ii, p. 564 (1842).



Text-fig. 4.—*Nemachilus* from Afghanistan.
Lateral view of (*a*) *Nemachilus griffithii* Günther, type-specimen $\times\frac{3}{4}$; (*b*) *Nemachilus griffithii* Günther, young specimen $\times 1\frac{1}{3}$; (*c*) *Nemachilus griffithii* var. *afghana*, nov., type-specimen $\times 1$; (*d*) *Nemachilus farwelli*, sp. nov., type-specimen $\times\frac{2}{3}$.

ation in proportions, etc. It is for these reasons that I have still linked the Kabul river specimens with *N. griffithii.*

There are in the collection 17 specimens collected by Major A. E. Farwell in the Sar-i-Bulak stream, a tributary of the Helmand river, which appear to belong to *N. griffithii.* The specimens are young (Plate-fig. 1, and text-fig. 4*b*) and in all cases the fins are greatly damaged. However, in these examples the fins are relatively longer, the eyes are larger, the head is longer, and there are other points in which they differ from the typical examples, but, probably, all these differences are due to their juvenile state. It may, however, be indicated that these examples are very different from specimens of the same size of the form *afghana* referred to above from the Kabul river.

A fine specimen (plate-fig. 2 & text-fig. 4*d*) collected by Major A. E. Farwell in the Helmand river is so different in the form and shape of its caudal peduncle, general facies and proportions that it seems to represent a form hitherto undescribed. It is associated with the name of Major Farwell in slight recognition of the interest taken by the officers of the British Legation at Kabul in making known the ichthyology of this interesting region.

Nemachilus griffithii var. **afghana,** nov.

1933. *Nemachilus griffithii,* Hora, *Journ. Bombay Nat. Hist. Soc.* xxxvi, pp. 697-699, pl. i, figs. 1 & 2.

Major A. E. Farwell obtained 4 young specimens ranging in length from 54 mm. to 97 mm. including the caudal fin from the springs at Sar-i-Chashma, the source of the Kabul river. Griffith[1] remarked that 'In the small channels by which the springs run off, a loach is very common'. These specimens agree very closely with the examples described by me (1933) from the Paghman river. It has to be noted, however, that the latter were not well preserved and the swollen nature of the opercular region was a mere artifact. Both the lips are fleshy and plicated; the lower lip is very narrowly interrupted in the middle. The colour varies with the size of the specimens. Along the lateral line there is either a series of rounded spots, a moniliform band or a grayish streak. The caudal fin is more or less truncate and not emarginate.

A young specimen of the species was also collected by Sir Richard Maconachie in the Chahiltran stream, a tributary of the Kabul river about 6 miles to the west of the Kabul City.

Type-specimen.—No. F $\frac{11525}{1}$, *Zoological Survey of India, Indian Museum, Calcutta.*

Nemachilus farwelli, sp. nov.

(Pl.-fig. 2; text-fig. 4*d*.)

D. 2/7; A. 2/5; P. 1/11; V. 1/8; C. 16 (besides smaller rays at the sides).

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[1] Griffith, *Calcutta Journ. Nat. Hist.*, ii, p. 564 (1842).

The new species of *Nemachilus*, which I have great pleasure in associating with the name of Major A. E. Farwell, Military Attaché to the British Legation at Kabul, has a very characteristic form. It is somewhat broad and depressed in the anterior region, but behind the dorsal fin it is greatly compressed from side to side. The tail portion is long and oar-like. All along the dorsal surface behind the head, the neural spines of the vertebrae form a prominent ridge. The following measurements give an idea of the form of the fish:—

	mm.
Height of head in the region of eyes	9·0
Height of head at occiput	10·6
Greatest height of body above middle of pectorals ...	12·7
Height of body at the commencement of dorsal fin ...	10·3
Height of body at the commencement of anal fin ...	7·8
Least height of caudal peduncle	6·8
Width of head in the region of eyes	11·7
Width of head in the opercular region	14·7
Width behind bases of pectorals	11·7
Width at the commencement of ventrals	6·5
Width at the commencement of anal	4·3
Least width of caudal peduncle	1·6

The dorsal profile is slightly arched, but the ventral profile is straight and horizontal throughout. The ventral surface is flattish and the paired fins are horizontally placed.

The head is depressed on both the dorsal and ventral surfaces; its length is contained 6·1 times in the total length with the caudal and 5·1 times without the caudal. The width of the head is contained 1·5 times and its height 2·1 times in its length. The snout is almost equal to the height of the head at the occiput. The eye is dorso-lateral in position and is not visible from the ventral surface; its diameter is contained 5·3 times in the length of the head, 2·4 times in the length of the snout, and 1·3 times in the interorbital width. The interorbital arc is almost flat. The nostrils are well developed and are situated much nearer the eye than the tip of the snout. The dorsal surface of the head is marked with series of lateral line organs which will be described below. The mouth is inferior, transverse and crescentic; it is situated considerably behind the tip of the snout and is co-extensive with the width of the head. The lips are well developed, fleshy and continuous at the angles; the lower lip is narrowly interrupted in the middle line. Both the lips are greatly fimbriated; the lower lip leaves the jaw bare anteriorly. Both the jaws are strong and well developed; the anterior jaw lies in front and forms a hood-like covering over the posterior jaw which is provided with a sharp, rasping edge and is shovel-like. There are 6 barbels which are longer than the diameter of the eye; the maxillary barbels are the longest, but they are considerably shorter than half the length of the head. The gill-opening is lateral, extending for a short distance only on the ventral surface.

The body is smooth and devoid of scales; its greatest depth is contained 11 times in the total length with the caudal and 9·2 times without it. The lateral line is complete and forms a ridge-like prominence on the body. The lateral lines of the two sides are united dorsally by a transverse series of perforations along the posterior border of the head. Each lateral line is continued forwards to the middle of the eye where it is divided into two branches, the dorsal reaches the nostrils, while the ventral branch extends as far forwards as the angle of the mouth.

The dorsal fin commences slightly in advance of the ventrals, and its longest ray is considerably greater than the depth of the body below it. The commencement of the dorsal is nearer tip of snout than base of caudal; its free end is truncate. The pectorals are broad and horizontal in position; they are somewhat shorter than the head and are separated from the ventrals by a considerable distance. The ventrals are long and pointed, and extend beyond the anal opening, but do not reach the base of the anal fin; they are slightly shorter than the pectorals. The anal fin is similar to the dorsal. The caudal fin is almost as long as the head and is slightly emarginate. The caudal peduncle is oar-like; it is about 4 times as long as its least height.

The anal-opening is preceded by a tube in which there is a papilla-like structure. Between the anus and the anal fin there is a well-defined, narrow groove with raised margins. It is not possible to give the function of this structure which is very characteristic of the species.

The colouration in the spirit specimen is almost black along the dorsal surface and dirty white on the ventral surface. There are few indications of regular spots on the body below the lateral line. The dorsal and the caudal fins are marked with several indistinct bands and the other fins are also provided with a few irregular colour patches.

Locality.—Helmand river, Afghanistan.

Type-specimen.—No. F $\frac{11515}{1}$, *Zoological Survey of India, Indian Museum, Calcutta.*

Remarks.—In general facies *Nemachilus farwelli* is remarkable, and though I have handled big collections of Nemachili, I have not come across any form approaching it in the shape of its caudal peduncle. The position of the dorsal fin and the nature of its lips are other distinguishing characters. The well-marked groove between the anus and the anal fin is also characteristic of the species. *Nemachilus farwelli* has no resemblance to the species of

Adiposia[1] *A. macmahoni* (Chaudhuri), *A. rhadinaea* (Regan) and *A. boutanensis* (McClelland)—known from the lower reaches of the Helmand system. *N. tenuis* Day, which has been recorded from the Helmand river,[2] possesses a rounded, slender and long caudal peduncle.

Measurements in millimetres.

Total length including caudal	140·0
Length of caudal	22·0
Depth of body	12·7
Length of head	22·8
Length of snout	10·5
Interorbital width	5·5
Diameter of eye	4·3
Width of head	14·7
Height of head at occiput	10·6
Longest ray of dorsal	20·8
Length of pectoral	20·0
Length of ventral	19·0
Longest ray of anal	18·0
Length of caudal peduncle	27·2
Least height of caudal peduncle	6·8

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[1] Annandale & Hora, *Rec. Ind. Mus.*, xviii, pp. 182-190, text-figs. 10, 12-15, pl. xv, fig. 4; pl. xvi, figs. 1 & 2 (1920); Hora, *Journ. As. Soc. Bengal* (n.s.), xxiv, pp. 481, 482, fig. 1 (1929).

[2] Hora, *Rec. Ind. Mus.*, xxiv, p. 77 (1922).

TRANSFORMATIONAL DECEPTIVE RESEMBLANCE AS SEEN IN THE LIFE HISTORY OF A PLANT BUG (*RIPTORTUS PEDESTRIS*), AND OF A MANTIS (*EVANTISSA PULCHRA*).

BY

A. P. Mathew, M.A.,

(*Lecturer in Zoology, H. H. The Maharajah's College of Science, Trivandrum*).

(*With a plate*).

Riptortus pedestris.

While making a collection of ant mimics from Mavalikara, Central Travancore, in 1930, I came across certain bugs which were moving about on *Cassia occidentalis* and which presented a very perfect resemblance to the Red Ant, *Oecophylla*—even more perfect than the mimicry which I was observing and studying in the Attid spiders. On closer examination I found a number of other bugs, imitating other ants, also moving about in close proximity. Some were smaller and lighter coloured—the very images of *Plagiolepis* ants; others were quite dark and larger, resembling perfectly certain species of Black Ant, *Camponotus*. Whether these ant mimics were separate species or merely successive stages of the same species or of different species could not be ascertained. So a number of them were collected and reared in cages at home. Their development showed that these bugs were only successive stages in the life history of a common *Coreid* bug (*Riptortus pedestris*) which, by the way, when fully grown, has no resemblance to an ant. Desiring to work out this interesting life history I secured a few males and females and reared them in cages at home. They paired and laid eggs. These hatched and the stages were followed.

The Eggs.—These when freshly laid are of a greenish colour but soon become dark brown. They are more or less oval structures attached singly to the leaves of *Cassia occidentalis* or to any other convenient object. The upper surface of the egg is flattened and broad, while towards the base, by which it is attached to the leaf, it becomes narrower. A female seems to lay only 8 to 10 eggs at a time.

The eggs hatch in 6, 7 or sometimes 8 days. The upper broad part is slit and lifted away like a lid and the young one crawls out of the egg case. Even as it crawls out it appears to undergo the first moult—the shrivelled up cast off skin is left peeping out of the egg case (Figs. 1-A & B).

The First Stage.—The young bug, immediately after it has come out of the egg case is of a beautiful red colour which gradually turns brown from the abdomen forwards and in a short time becomes quite dark brown. It is a perfectly ant like little insect there being no trace of the dorso-ventral flattening of the body, so characteristic of the *Hemiptera*. The large head followed by an elongated and cylindrical thorax, at the end of which is the swollen oval abdomen, gives this insect its striking ant-likeness.

The resemblance is increased by the antennae, usually extended forwards and waved to and fro as the insect moves about. In colour, general movements, size and appearance, it is almost indistinguishable from the small dark brown ants—*Prenolepis longicornis*—so common here (Figs. 2 & 3).

The *Coreidae* as a family are characterised by a disproportionate enlargement of the third pair of legs; but in these newly hatched young there is no such enlargement.

The head is oblong, longer than the pronotum and produced in front of the eyes. Behind the eyes it is convex. There are a number of short stiff white hairs on the head, directed forwards. Antenna four jointed, slightly longer than the body, the fourth joint being the longest. The eyes are prominent, placed slightly behind the middle of the head; ocelli absent. The rostrum reaches a little beyond the second coxa. It is four jointed, the first joint being stout and less than half the length of the head. The second and third joints are each more or less equal in length to the first, but the last joint is a little longer.

Just behind the head, at the neck region there is a narrow white band forming a 'collar'. The thorax is much elongated and almost cylindrical, quite unlike the usual hemipteran thorax. The characteristic pronotal angles are not developed. The pronotum is short, convex dorsally and on the sides, and truncate behind.

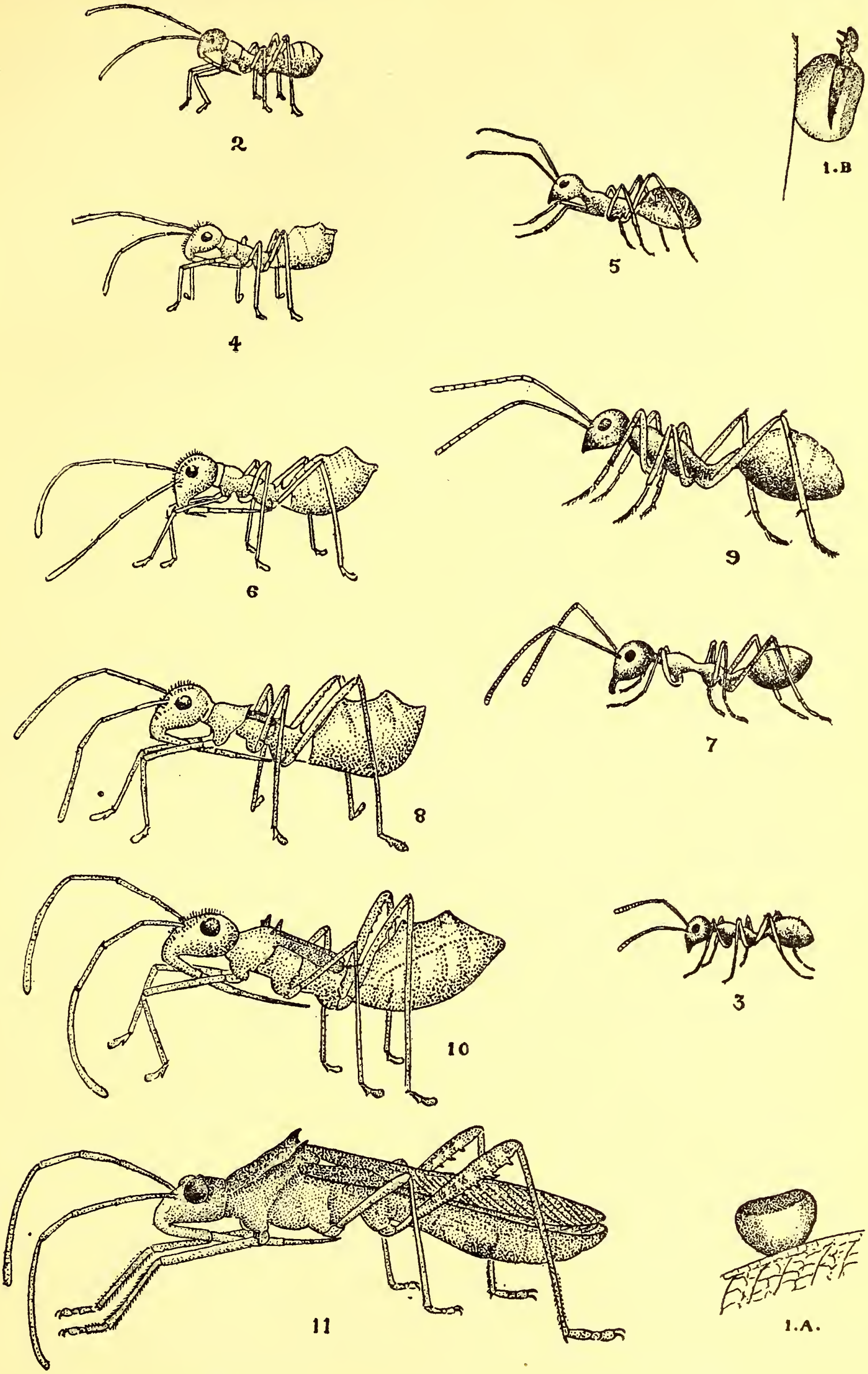
Behind the thorax, in the anterior part of the abdomen, is a broad white band ventrally, extending upwards in triangular patches on either side, which effectively produce the appearance of the narrow 'waist' of the ant. The abdomen is globose with dorsal stink glands.

A specimen prior to the next moult measured 3·3 mm. When just hatched it measured only 2·2 mm.

The Second Stage.—In two days' time the young bugs moult. The similarity to the ant becomes intensified. The bug, now larger and more elongated, is of a bright yellowish-brown colour. Its antennae are long and held forwards. In coloration, general appearance and movements, it now bears a very striking resemblance to a *Plagiolepis* ant. At Mavalikara, where I have seen large numbers of these bugs breeding under natural conditions, I have mostly come across the young bugs at this stage on their food-plant, in company with many *Plagiolepis* ants which roam over it. Distinction between the young bugs and the *Plagiolepis* ants is by no means easy. The bug's mimicry at this stage is almost perfect (Figs. 4 & 5).

When the *Plagiolepis* ants are disturbed they run about wildly and many of them fall to the ground. The young bugs behave in a similar manner. When disturbed they quicken their pace, run about wildly and often fall down into the debris below. This must be protective; once among the debris, with many of the ants moving about detection of the bugs is almost impossible.

The general build of the body is the same as in the previous stage. The head in front of the eyes is pubescent with white hairs directed forwards. Behind the eyes there are a few stouter and shorter black hairs directed upwards in the middle, and outwards


2
1.B
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1.A.

Trans-deceptive resemblances as seen in the life-history of a Bug (*Riptortus pedestris*).
(*For explanation of plate see end of article.*)

on the sides. On the thorax are a few black hairs mixed with white. The abdomen bears shorter and softer white hairs. The rostrum has the third joint shortest and the fourth the longest. The hinder border of the mesonotum develops a median extension backwards—the beginning of the scutellum. The first two segments of the abdomen are narrow. The first segment has a small process projecting upwards. The second segment has two broad triangular white patches, one on either side, which mask a good region of the sides, and produce the appearance of a narrow 'waist'—so characteristic of the Hymenoptera, but not found in the Hemiptera. Immediately beyond this, the abdomen is swollen and globose. On the dorsal surface are two tubercles on which the stink-glands open.

In this stage, while the majority retained their reddish-yellow coloration, a few showed a tendency to turn darker. Some turned dark-red while others became quite dark. The latter individuals thus lost all similarity to *Plagiolepis* ants; but their appearance and colour made them almost indistinguishable from the smaller individuals of a species of *Camponotus* ants which are also common in the locality.

A specimen in this stage measured 4·4 mm.

The Third Stage.—The next moult takes place within 4 to 6 days. During this moult variations in colour are even more pronounced than in the previous stage. Some of the reddish-yellow forms on moulting retain the reddish yellow coloration; others turn several shades darker while a third lot turn quite dark. The dark-red forms and the dark forms on moulting to this stage produce the dark types. Thus in this third stage there are three forms of bugs—reddish yellow, dark reddish, and black. An attempt was made to ascertain if this change of coloration had any relation to the colours of the surroundings. Individuals were reared in different backgrounds but the results were negative. Whatever the nature of the background the bugs on moulting seemed to produce all three colour forms. Nor does variation in colour depend on the food; for they are all fed on the same diet.

The reddish-yellow forms bear the closest possible similarity to the red ant, *Oecophylla smaragdina*, in size, coloration, and general build of the body. The ant's abdomen has a conspicuous black mark on its under side and it is quite striking to note a similar dark patch on the ventral side of the swollen part of the abdomen of the bug. In both, ant and bug, this black patch is an internal structure seen through the translucent abdomen and not a superficial mark. The ant, when alarmed raises its abdomen—an act which makes this mark quite visible; the bug too, raises its abdomen as it moves about, though to a much less extent. Thus its behaviour is very similar to that of the ant. The antennae are ordinarily held either forwards or sideways with a distinct bend or 'elbow', a little above the base, thus simulating the elbowed antennae of *Oecophylla* (Figs. 6 & 7).

The ants and the bugs are frequently found on a species of *Cassia*. The bugs ordinarily remain stationary on the leaves or pods; the ants though by nature very active are often reduced to passivity when stroking the glands of or 'milking' aphides. When disturbed the bugs become active and move about quickly after the fashion of the ants. They often fall down from the plant to the debris below when disturbed—which *Oecophylla* seldom does though some other ants do it. This, as has been already explained, must be an additional protective device.

The general build of the body of the bug is similar to that in the previous stage; but a closer examination shows that traces of the adult characteristics have begun to form, though still not quite obvious at a casual glance. The pronotum is shorter than broad and, at the hinder margin, the pronotal angles are distinct. The hinder margin of the mesonotum is seen to be divided into three lobes projecting backwards—two lateral and one median. The lateral lobes represent the incipient tegmina while the median lobe is the hinder end of the scutellum.

The rostrum reaches to between the third coxa. The third joint is the shortest and the fourth the longest.

The first abdominal segment has a well developed spine projecting upwards. The hinder portion of the abdomen is globular. Dorsally on this globular portion are two tubercles on which the stink glands open.

A specimen in this stage measured 6 mm.

The Fourth Stage.—The next moult takes place in 2 to 4 days. All the black specimens when moulted retained the dark colouration. Some of the reddish ones on moulting retained their colour, others became dark like those produced from the dark ones. Some which retained the red coloration on moulting, gradually changed several shades darker as they grew. Perhaps this is only an instance of delayed pigment development. In all instances, when just moulted, the specimens are reddish; the dark ones attain their colour only after a short interval. In this stage therefore, there is a definite preponderance of black, the lighter-coloured individuals being few.

Red individuals still continue their resemblance to *Oecophylla* though, as they grow fast and the body gets more enlarged, the similarity decreases. The characteristics of the adult get more evident. It is from this stage then that the typical *Hemipteran* and *Coreid* characters become more clearly distinguishable in these bugs and the ant-likeness gradually lessens. The more pronounced development of the scutellum, tegmina and the wings, pronotal angles, etc., make the bugs more or less easily distinguishable to a careful observer, though at a casual glance, these may yet be overlooked. Black individuals still mimic the *Camponotus* ants, the larger individuals of the ants serving as models now. Still, as in the case of the red ones, the distinctions have already become evident and the mimicry is much less perfect than in the earlier stages. It is also to be noted that the bugs now become more sluggish in their movements compared to the earlier stages.

Compared with the previous stage the bugs show marked differences in the thorax. It loses the cylindrical nodular form which gave it such a striking similarity to the curious thorax of the *Oecophylla*. It is now slightly flattened above and the scutellum and the rudiments of the tegmina and the wings are all distinct. The pronotal angles are well-developed. The white triangular patch on either side of the anterior region of the abdomen is still distinct. The last leg has become comparatively stouter than in the previous stages and the femur just shows the beginnings of the spines which are so characteristic of the adult (Figs. 8 & 9).

The total length of a specimen measured was 8 mm.

The Fifth Stage.—The specimens moulted to the penultimate stage in 4 days. They have now grown considerably larger and have a dirty dark-brown colour. The almost exact ant-likeness of the previous stages is lost, though a general resemblance may still be recognised (Fig. 10).

The dorsal surface of the pro-thorax slopes upwards and posteriorly inclining at an angle of 45°, thus producing a bend for this region which is characteristic of the adult but is absent in the previous stages, where the pronotum is quite horizontal. The hinder border of the pronotum projects backwards as a distinct ledge, bearing spines at the angles and also one spine in the middle at the base of the scutellum. Behind the first coxa and faintly behind the second also, are marks representing the stink glands of the adult. The glands are being formed; but they are not yet open.

The abdomen is still swollen but has lost the almost globular shape of the previous stages. Seen from above it is more or less lozenge-shaped in outline having the centre considerably raised. Here are the stink-glands which are to close up by the next moult. Posteriorly the abdomen tapers. The 'waist region' so deceptively formed by white patches in the previous stages has disappeared altogether.

Length of a specimen measured was 11 mm.

In this as also in the previous stage, the bug presents a very striking similarity to *Dulichius* and strangely enough on comparing the specimen with the description of *Dulichius inflatus* as given in the F.B.I. they were found to agree in most respects. A few specimens were sent to the Indian Museum and I was informed that these specimens should certainly be put in the genus *Dulichius* and quite probably are *D. inflatus*. From this species, however, it differs slightly in the proportionate length of the rostral joints. In the nymph though the second joint is the longest, it is longer than the third and fourth joint together. In *Dulichius*, however, the second is the longest being a little longer than the third and the fourth together. But for this, in all other details, the two appear to agree perfectly. Curiously enough, the single specimen of *Dulichius inflatus* in the Indian Museum, in this respect, agrees with these nymphs and differs from the description in the F.B.I. since in this specimen also the second joint is not longer than the third and the fourth together. Perhaps it is this or a similar stage of some closely-allied form that has been described as *D. inflatus*. What Dr. Bergroth remarks with reference to the specimens sent by Mr. Wroughton is quite interesting. He says 'Mr. Wroughton has only found the brachypterous form. If the species has a macropterous form it is probable that the form has little or no resemblance to an ant' (Ent. Month. Mag., 1892, 107).

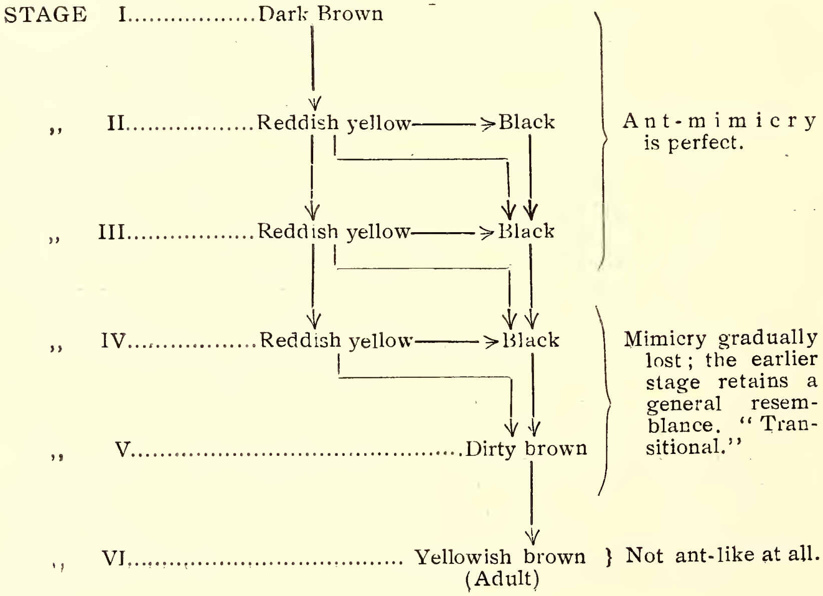
A number of bugs have been described without wings but which later on were found to have fully-winged forms—for example, *Eugubinus*. The case of *Dulichius inflatus* might be only similar; it is only the nymph of a *Coreid* bug with fully-developed wings in the adult stage during which there is absolutely no trace of ant-likeness.

The Sixth Stage.—The next moult, by which the bugs become adults takes place in 5 to 8 days. The moulting is similar to the previous ones. The cuticle splits at the median line on the thorax and the thorax is first pushed out, the head being bent double. Then gradually the insect pushes itself forwards, drawing out the limbs, antennae and rostrum. The hinder part of its abdomen still remains in the old skin. The wings are pale and do not reach up to the tip of the abdomen. The legs and antennae are raised and slowly moved about. The bug is now of a beautiful coral red colour with lighter bands on the legs and antennae. As the cuticle hardens this colour changes to a dirty-brown.

The adult has no likeness to the ant and is of a dull brown colour. The wings are developed; ocelli are present; abdomen typical; tarsus three-jointed. As the bugs sit quietly on the dry pods of *Cassia occidentalis* or on its withered leaves—a position where they are quite often encountered—they are quite unrecognisable. They have the habit of collecting together in small numbers on the dry pods. The hind legs are much enlarged as in all the *Coreidae;* in the earlier stages this was not marked (Fig. 11).

The total length of a specimen measured was 15 mm.

General Remarks.—The life-history sketched above is a very curious and interesting one. It may be represented thus:—


STAGE I..................Dark Brown
,, II..................Reddish yellow——>Black
,, III..................Reddish yellow——>Black
,, IV..................Reddish yellow——>Black
,, V..Dirty brown
,, VI.. Yellowish brown (Adult)
Ant-mimicry is perfect.
Mimicry gradually lost; the earlier stage retains a general resemblance. "Transitional."
Not ant-like at all.

The different colour-patterns produced at a moult is instructive. Black seems to be the dominant colour. Black individuals always retain their colour on moulting, except in the last two stages where all individuals once again assume a uniform coloration. The reddish-yellow young on the other hand remain reddish-yellow or change to black. That this variability does not depend on the surroundings or on the food has been already pointed out; and my observations have shown conclusively that it does not depend on sex either.

Such a variability has been also noted by Vosseler (1909) in his classical account of *Myrmecophana* (synonym *Eurycorypha*), the life-history of which is in many ways similar to the one described here. In Vosseler's grasshopper, at the first stage all the nymphs are black; in the next stage a few brown ones appear and in the third stage the number of brown specimens increases and a few individuals of intermediate shade arise. In both cases the ant-likeness gradually vanishes. The variability of coloration also ceases, the individuals all developing a more or less uniform colour.

This tendency to produce differently shaded individuals during the immature ant-like stages seems to me, a very significant phenomenon though no one as yet appears to have drawn attention to it. In places where I have come across numbers of these bugs, breeding under natural conditions on *Cassia occidentalis*, I have also seen different types of ants. Thus *Prenolepis*, some species of *Dolichodorinae*, *Camponotus*, *Solenopsis*, *Plagiolepis*, *Oecophylla* and a few more forms were found on adjacent plants or, quite often, two or three of these types were on the same plant. The ants haunt these plants for the sake of the aphides which live on them or to suck the 'glands' found at the bases of the leaves. It often happens that one form of ant may desert one plant and establish itself on another. *When we consider this variability of the companion ants found on any plant, the significance of this dimorphism becomes evident. In an environment in which either black or the reddish models may be found, or with equal possibility both together, a rigid adherence to one form alone may not be so advantageous as the use of both colour forms as models.* The chances of deception and hence of protection are therefore increased.

It is instructive in this connection to recall the instance of the green and brown larvae of the Large Emerald Moth (*Geometra papilionaria*) mentioned by Prof. Poulton (1890), which resemble the catkins of the birch. There are green and brown larvae just as there are green and brown catkins. Commenting on this, Beddard (1892) says 'Thus a larger number would have a chance of escaping the attention of insect-eating birds than if the caterpillars were all green or brown'. The same argument with even greater force is applicable to the present instance; *the nymphs are dark or reddish-brown just as the ants of the vicinity may be either dark or reddish-brown species.*

That this mimicry is protective is generally accepted. On one occasion I removed a few of these bugs to a plant where there were no ants. After a while I came back to look at them and saw a number of *Attid* spiders each holding a bug in its jaws.

Evidently the mere ant likeness was no sufficient safety; but it is significant that on plants with plenty of ants these spiders were seldom seen.

The transformation of the typical ant-like nymph into the adult bug without any ant-like appearance is brought about by gradual stages, there is no sudden or abrupt transformation. This is evident from the description given above of each stage. In addition to those points already referred to, mention may be made of one or two others which are of considerable interest since they concern characters which are much used in classification.

The adult *Riptortus* like most *Coreidae* lacks bright colouration and has a disproportionately enlarged third leg with spines on the femora. Its pronotum posteriorly is broader than the head and, in the four-jointed rostrum, the third joint is the shortest and the second the longest. The early nymph however differs from the adult in all these characters. The juicy reddish and yellowish colour of the nymph is not quite inconspicuous; the third legs are normal and the femora bear no spines; the pronotum posteriorly is not broader than the head and in the rostrum the second and the third joints are of equal length.

At every moult there is a short step taken forward in the direction of the adult characters. The third leg shows a gradual enlargement. Thus the ratio of the length of the third leg to that of the first leg is 1·3 in the first stage, 1·5 in the later stages and 1·7 in the adult. The femora of the third leg begins to develop spines from the fourth stage. It is interesting that it is at this stage that the other adult peculiarities also become evident. Thus the thorax loses its cylindrical nature and the tegmina and the scutellum appear. In colouration also, the rich reddish hue of the previous stages vanishes, though still retained by a few, most nymphs put on a dark garb to soon become grayish at the next moult. In the rostrum, the ratio of the second to the third joints is 1 in the first stage, where both the joints are equal, $1\frac{1}{2}$ in the next stage, $1\frac{3}{4}$ in the third stage and in the fourth stage it is 2, which ratio continues for the succeeding stages. Thus in the fourth stage the adult proportions have been already reached. The ratio of the second joint to the third and the fourth together appears to increase steadily up to the penultimate stage; the ratio are ·4, ·5, ·6, 6·6, ·7 and 7·6 respectively.

Evantissa pulchra.

Evantissa pulchra is a common green mantis found on low shrubs. Its uniform green colour makes it quite inconspicuous on its foliage where it sits quietly watching for any tiny insect that might unwarily get within its grasp. Its cryptic green coloration protects it from its enemies.

Mr. Henry of the Colombo Museum to whom I sent my specimens from Trivandrum for identification informs me that this is one of the commonest mantises of Ceylon.

On the 29th October 1930, I secured a gravid female and kept it in a glass cage. The next day she began to make the egg case and to lay her eggs. On the 21st November they hatched. I was not able to observe the actual emergence of the nymphs from the egg case. When I looked at the egg case early in the morning, I was surprised to see a cluster of small yellowish ants covering it. Fearing that the cage was not properly closed and that the ants had got in and were destroying the eggs, I disturbed them to drive them away. To my great surprise I saw that my supposed ants were a number of small mantises, each a very striking imitation of the *Plagiolepis* ant.

This yellowish colouration of the mantis, however, does not last long. It gradually gets darker and darker till in about 15 minutes from the time of hatching it is quite dark. This change is to be looked upon as only due to the chitin which develops normal coloration as it hardens. A dead specimen was also noted to undergo the darkening.

These mantises are perfect mimics of the common black ants, *Camponotus compressus*. The *Camponotus* ants are graded in different sizes which serve the early and grown-up mantises of this stage as models. The young black mantis feeds voraciously and grows fast. As it gets larger the glossy black colouration fades a little. It undergoes its first moult in about three weeks.

In the subsequent stages the ant-mimicry gets less and less pronounced. The colour gradually turns dark-brown and the legs turn greenish. Specimens kept in cages were found to be darker than the individuals of the corresponding stages obtained from the field. The succeeding moults took place within 7 to 12 days till they reached the penultimate stage. In this stage the nymphs are long and stout having the legs and the ventral side of the body, greenish. The dorsal side is still of a light dark colour. Rudiments of the wings are clearly visible. The last moult took place in two weeks.

Evantissa pulchra begins life as an ant-mimic. From the second stage onwards the ant-mimicry is gradually lost till in the adult stage it is green and leaf-like. The life-cycle takes about 10 weeks—3 weeks for the hatching and 7 weeks for the young to attain the adult characteristics.

Transformational Deceptive Resemblance.

In an earlier paper on the life-history of the spider *Myrmarachne plataleoides* (1934) I have drawn attention to those curious transformations noted in the protective methods exhibited by a particular organism in the different stages of its life-cycle. The few instances known to us may fall under three divisions:—

(i) Those, which like Vosseler's *Myrmecophana* (1909) or Hingston's *Isopsera* (1929), begin life as ant-mimics. By gradual steps they lose the ant-likeness and become green and leaf-like, thus depending upon cryptic coloration for protection. *Evantissa pulchra* is an example of this class.

(ii) Those, which like *M. plataleoides* (1934), stick to one method of protection all through life viz. ant-mimicry. To make this mimicry effective in different stages of its growth different ants of the suitable sizes are used as models.

(iii) The life-history of *Riptortus* agrees with the first division since it seeks protection by ant-mimicry in the earlier stages and at the final stage loses this ant-likeness and puts on a brownish inconspicuous coloration. But, unlike the instances given under this section, here the ant mimicry is considerably prolonged extending over a number of the earlier stages. During these ant-mimicking stages the nymphs imitate different types of ants of corresponding sizes, as is seen in the second section. To this may be compared Uvarov's account of *Leptoderes ornatipennis* (1922), one of the *Phaneropteridae* from Java. In this insect, the earlier larvae mimic certain tiger beetles of the genus *Collyris* while the later larvae resemble another tiger beetle *Tricondyla cyanea*. The adult is green and leaf-like. The life-history of *Riptortus* however appears to be more varied in imitation of other insects viz. ants,—each stage imitating a different ant and most stages marked by colour dimorphism enabling the individuals of a particular stage to mimic two different kinds of ants at least.

It is interesting to note that these strangely deceptive appearing larvae have been mistaken in many instances for separate insects and named and described as such by different observers. Thus the larva of *Eurycorypha* (Vosseler, 1909) was described as a new genus *Myrmecophana* by earlier workers. Mr. Uvarov has shown (1922) that the early larva of *Leptoderes ornatipennis* was described as *Tricondyla rufipes*, in mistake for a tiger beetle; and that two of the later larvae have also been described as *Condylodera* and *Trochalodera*. The Hemipteran parallel, whose life history is described above, also appears to have succeeded in a similar deception; for most probably it is the larva of one of its later stages, that has been described as a most peculiar bug under the name *Dulichius inflatus*.

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1934. Mathew, A. P., 'The Life-history of *M. palataleoides*', *Journ., Bomb. Nat. Hist. Soc.*, xxxvii, No. 2.

EXPLANATION OF PLATE.

1-A—An egg attached to the edge of a leaf.

1-B.—An egg after the young has hatched and escaped, showing the moulted skin peeping out of it.

2.—First instar, soon after hatching.

3. *Prenolepis sp.* the ant which is mimicked by the first instar (2).
4. Second instar.
5. *Plagiolepis sp.* the ant of which (4) is a mimic.
6. Third instar.
7. *Oecophylla smaragdina* the red ant which is mimicked by the third instar (6).
8 & 10. Dulichius stages—the fourth and fifth instars during which they mimic the Camponotus ants.
9. *Camponotus sp.* which is imitated by the fourth instar and to a less extent by the fifth instar.
11. The Adult *Riptortus pedestris.*

THE ORNITHOLOGY OF TRAVANCORE AND COCHIN.

BY

SĀLIM ALI.

With Notes by HUGH WHISTLER.

PART I.

(*With a map, 4 plates and 5 diagrams*).

INTRODUCTION.

Since the publication of Hume's[1] and Ferguson's[2] papers on the birds of Travancore, and Kinloch's[3] meagre but tantalising notes on the Nelliampathy Hills (Cochin), considerable advances have been made in our knowledge of the avifauna of Peninsular India, notably through the recent surveys of the Eastern Ghāts and the Hyderābād State.

In order to bring our information concerning the rest of the Peninsula uniformly up to date, it became desirable for a fresh and thorough investigation to be undertaken of that interesting strip of country, occupied by the States of Travancore and Cochin, which forms part of the coastal rain belt at the extreme south-west corner and is comprehensively known as Malabār.

Thanks to the keen interest traditionally taken by them in all matters connected with scientific research and education, the rulers of these States readily recognised the need and granted the facilities necessary for the carrying out of ornithological surveys in their respective territories. In this connection I am especially indebted to the two Dewans, Mr. T. Austin, I.C.S., of Travancore and Mr. C. G. Herbert, I.C.S., of Cochin, to whose sympathetic consideration of the initial representations, the Surveys owe their inception, and to whose personal interest throughout, their smooth and successful working.

It would be impossible here to acknowledge individually all the kindness and help the Surveys received during the course of their work, nevertheless there are some of whom special mention seems called for. Amongst such are Messrs. Dhanakoti Pillai, Conser-

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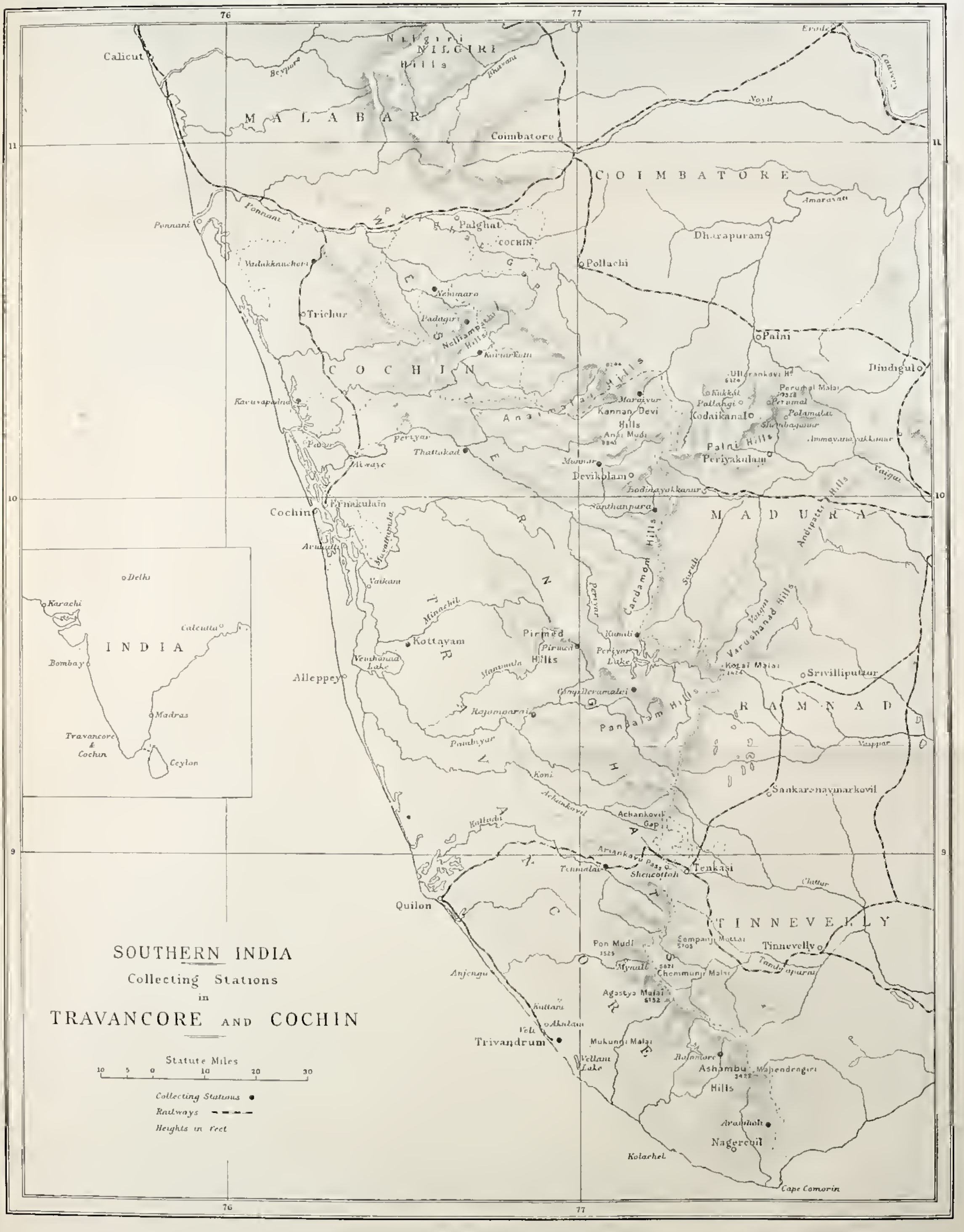
[1] 'A First List of Birds of the Travancore Hills', by A. O. Hume, *Stray Feathers*, vol. iv, pp. 351-405 (December 1876).

'A Second List of Birds of South Travancore', by A. O. Hume, *ibid.*, vol. vii, pp. 33-39 (August 1878).

[2] 'The Birds of Travancore', by Harold S. Ferguson, *Journal, Bombay Nat. Hist. Soc.*, vol. xv, pp. 249-264 (October 1903); pp. 455-474 (February 1904); pp. 654-673 (June 1904); vol. xvi, pp. 1-18 (December 1904).

[3] 'Rough Notes on the Avifauna of the Nelliampathy Hills', by A. P. Kinloch, *Journal, Bombay Nat. Hist. Soc.*, vol. xxvii, pp. 939-944.

'On the Birds of the Nelliampathy Hills', by A. P. Kinloch, *ibid.*, vol. xxix, pp. 564-565.



SOUTHERN INDIA
Collecting Stations
in
TRAVANCORE AND COCHIN

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MALABAR
Coimbatore
COIMBATORE
Erode
Cauvery
Noyil
Amaravati
Ponnani
Palghat
COCHIN
Dharapuram
Pollachi
Vadakkancheri
Nelliampathi Hills
Padagiri
Nemmara
Trichur
Kuriarkutti
Palni
Dindigul
COCHIN
Anamalai Hills
Marayur
Kannan Devi Hills
Anai Mudi
8840
Ullarankavi H.
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Pallangi
Perumal Malai
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Kodaikanal
Polamalai
Shembaganur
Palni Hills
Periyakulam
Ammayanayakkanur
Karuvapadna
Periyar
Thattakad
Parur
Alwaye
Munnar
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Bodinayakkanur
Vaigai
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MADURA
Cochin
Ernakulam
Santhanpara
Aruhutti
Muvattupula
Cardamom Hills
Suruli
Vaikam
Periyar
Minachil
Kottayam
Peermed
Peermed Hills
Kumili
Periyar Lake
Varushanad Hills
Kottai Malai
Srivilliputtur
Alleppey
Vembanad Lake
Manimala
Conjeeveramalai
Rajampara
Pandalam Hills
RAMNAD
Vaippar
Pambiyar
Koni
Achankovil
Achankovil Gap
Sankaranayinarkovil
Kalladai
Ariankavu Pass
Tenmalai
Shencottah
Tenkasi
Chittar
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Tambraparni
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Agastya Malai
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Akulam
Veli
Trivandrum
Mukunni Malai
Vellani Lake
Balamore
Ashambu Hills
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Mahendragiri
Aramboli
Nagercoil
Kolachel
Cape Comorin
Delhi
Karachi
INDIA
Calcutta
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Madras
Travancore & Cochin
Ceylon

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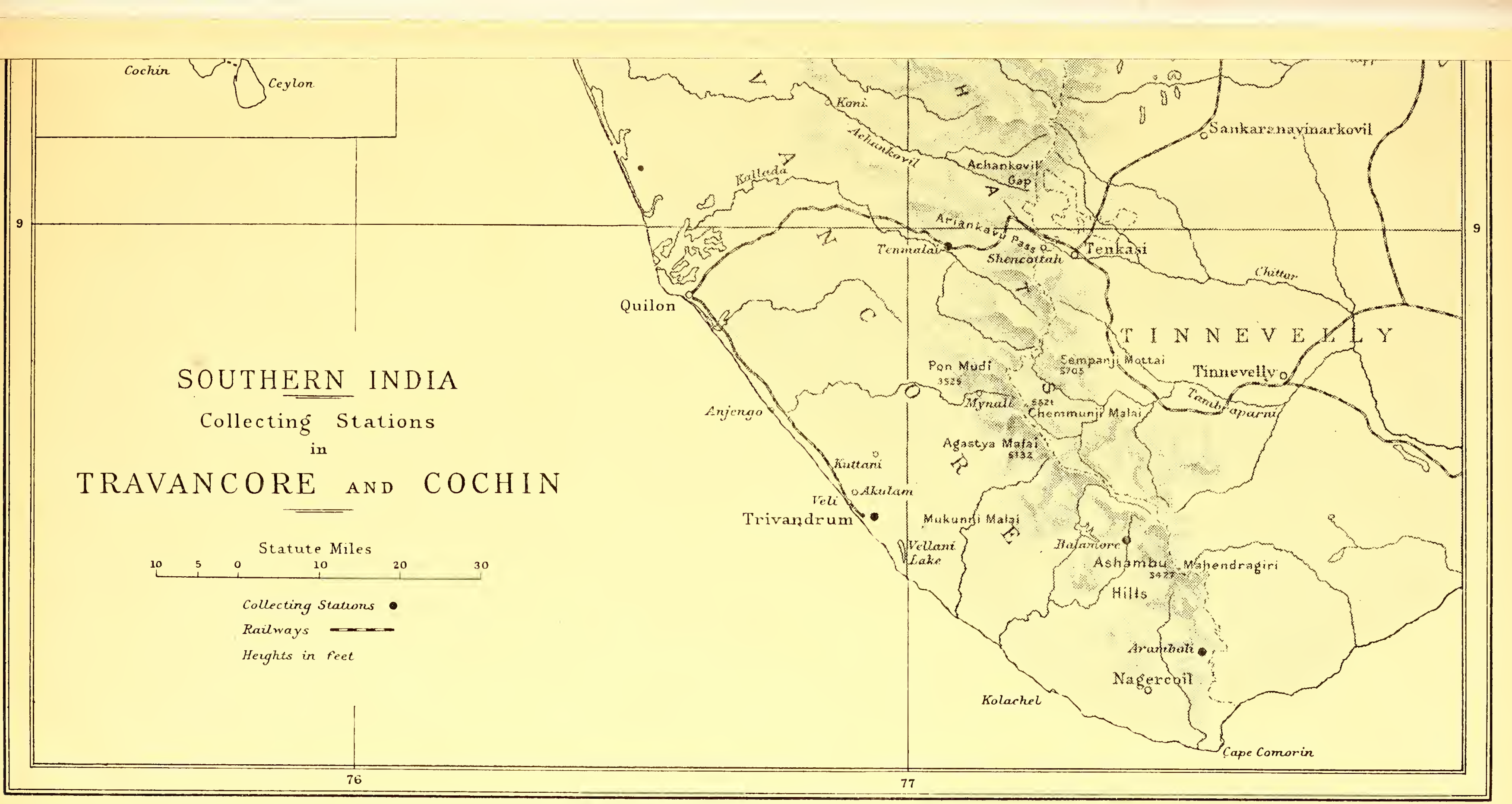
SOUTHERN INDIA
Collecting Stations
in
TRAVANCORE AND COCHIN

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vator of Forests, Travancore; K. Raman Pillai, Divisional Forest Officer, Kottayam; and T. Narayana Menon, Conservator of Forests, Cochin.

Mr. N. G. Pillai, Curator of the Trivandrum Museum, who was attached to the Travancore Survey on deputation and who subsequently volunteered his services in Cochin for as long as his official duties could spare him, also deserves a word of appreciation. The great keenness he displayed in the field is highly commendable, and it is to be hoped that his career may provide him with opportunities of devoting himself to the various ornithological problems peculiar to his part of the country. It is unfortunate that owing to his college term my young cousin Hūmāyūn Abdūlali could not join me earlier than he did in the Travancore Survey. His enthusiasm as a birds' nester contributed materially to this department of the Survey's activities even during the short time he was in the field.

Without the continued and active co-operation of the Bombay Natural History Society it is extremely doubtful if any work of this kind can be successfully undertaken in India. The amount of field research and organised collecting that has been carried out in recent years under the aegis of the Society, despite the universal economic depression, is an eloquent tribute to the push and resourcefulness of the people at its helm. For the Travancore Survey the Society again loaned the services of their skinner and rendered much other help in various ways in return for which their study collections will benefit appreciably.

To Mr. Hugh Whistler who deals with most of the systematic and taxonomic section of this paper and is virtually the author thereof, I wish to express my highest appreciation for his unfailing and continued interest and valued advice in the work of the Surveys. With the vast experience he has recently acquired in handling ornithological material from the Peninsula, it would have been impossible to wish for an abler collaborator. It is also due to him that an extra month's collecting by Mr. Pillai in the environs of Trivandrum town, after the Survey proper had concluded its work in the field, was made possible. Being in July-August, this has enabled us to deduce much useful information concerning the commoner resident birds of that locality.

I am greatly obliged to Mr. B. B. Osmaston, C.I.E., I.F.S. (Retd.), for the trouble he has taken in the preparation of the excellent diagram maps which accompany this paper.

It would not do to close this catalogue of acknowledgments without a mention of the help rendered in more ways than one by my wife. She accompanied the Surveys throughout, often when the travelling and living arrangements left almost everything to be desired, and was responsible for most of the tedious secretarial and writing-up work.

GENERAL.

The States of Travancore and Cochin, which adjoin each other, are treated here as one physiographical unit. They comprise the southernmost portion of Malabār which, in its widest sense, is the belt of country (rarely over 50 miles broad) lying between the Arabian Sea on the west, and the Western Ghats up to their watershed on the east. It stretches from about Goa to Cape Comorin and encompasses Kanara and Coorg, besides the British district of Malabār. The area here dealt with lies between 8°4′ and 10°45′ N. lat., and 76°14′ and 77°13′ E. long. It is very irregular in shape but roughly triangular, the base being the Arabian Sea coastline. Its greatest length is about 210 miles and greatest width about 75. The combined area of the two States is 9,042·75 sq. miles, Travancore being 7,625 and Cochin 1,417·75.

The western half of the northern boundary is represented by the Shorānūr or Ponnāni River, the eastern half by that curious break known as the Palghāt Gap—a transverse valley which cuts abruptly across the Western Ghats, sharply dividing the Nelliampathies of Cochin from the Wynaad and Nilgiri Hills, and carrying plant species characteristic of the Malabār flora almost across the Peninsula. The frontiers on the two other sides are defined by natural features: all along the west is the Arabian Sea, while on the east the Western Ghāts separate the area from the adjoining British districts of the Madras Presidency—mostly flat and dry except in the western portion of Madūra between about 9°30′ and 10°30′ N. lat., which contains the Pālni, Varūshnād and other hill ranges. In physical characters these latter are essentially the same as the Travancore and Cochin hills and therefore, for the sake of greater completeness, I have included in my notes the gist of Fairbank's[1] and Terry's[2] contributions to the ornithology of the Pālni Hills.

The country exhibits considerable diversity of terrain, but is broadly divisible into three well-defined parts: the hills, the plains and the seaboard. The northern parts, especially where the two States meet, are abrupt and mountainous. Stretching westwards in gentler slopes and gradually widening valleys, but broken here and there by isolated low hillocks, the plains succeed the forest-clad uplands. Intersected by numerous rivers and streams, dotted everywhere by homesteads and farms and closely cultivated whereever possible, these plains extend in a succession of undulations towards a line of backwaters on the coast. In the southern and drier portions, the country closely resembles Tinnevelly, the adjoining Madras district, but is less arid and sterile.

The mountainous character is due to the Western Ghāts, sections of which are known here under different names. From north to south these are as follows:

1. The Nelliampathy Hills with a maximum elevation of about 5,000 ft. comprise a section of the Ghāts which, rising abruptly on the southern boundary of the Pālghāt Gap, extends for some 20 miles south. They lie between 10°26′ and 10°42′ N. and 76°31′ and 76°52′ E.

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[1] 'A List of Birds collected and observed in the Pālani Hills', by Rev. S. B. Fairbank, *Stray Feathers*, vol. v, pp. 387-410 (December 1877).

[2] 'A Few Additional Notes on the Birds of the Pulney Hills', by H. A. Terry, *Stray Feathers*, vol. x, pp. 467-480 (December 1887).

2. The Annemalāi Hills in the N.-E. portion of Travancore extend into the south-west corner of Coimbatore District on the one hand and northward into Cochin on the other, where they merge into the Nelliampathies. Annāimūdi (8,841 ft.) the highest peak in this range and also the highest in South India (10°10′ N. × 77°4′ E.) in North Travancore, is surrounded by many hills of over 7,000 ft.

3. The High Range, arising in the Annemalāis, includes the Kanan Dēvan Hills. South of these the section is termed Cardamom Hills which in turn merge farther south into Peermade, where the land spreads out in a plateau of considerable width with hills rising up to 5,000 ft.

4. South of the Cardamom and Peermade Hills, which section may be said to terminate at the Periyār Lake, begin the Panthalam (or Pandalam) Hills which run until a gap or pass across them is reached at ca. 9° N. lat., known as the Achankovil Gap.

5. South of Achankovil Gap and of another pass, the Ariānkavū (through which runs the railway line connecting Trivandrum with Madras), the hills continue to within a short distance of Cape Comorin, this section being the Ashāmbū Hills. In the main they consist of a ridge at an elevation of about 4,000 ft. with isolated peaks of which Agāstyāmalāi (6,132 ft.) and Mahendrāgiri (5,427 ft.) are the most important.

From the main range of the Ghāts, which includes all the above sections, rocky spurs run out to the west, in some cases to within a short distance of the sea. From Quilon (8°53′ N. × 76°35′ E.) southwards, these secondary ranges soften down to undulating slopes intersected by glens and valleys which grow wider as the elevation of the hills decreases, and are very fertile.

Owing to the mountainous nature of the country, streams are numerous. They have mostly very winding courses and the majority discharge themselves into the backwaters. The largest river is the Periyār which rises at about 3,000 ft. in the Sivāgiri forests roughly between 9° and 9°30′ N. × 77° and 77°30′ E. and falls into the sea through the backwaters at about 10°11′ N. × 76°10′ E. Near its mouth (in Cochin) it is known as the Ālwaye River. There are other streams of fair size of which the Chālakūdi in Cochin and the Mināchil, Pambiyār and Kodayār in Travancore may be mentioned.

A chain of backwaters and canals extends along the coast from almost the northernmost frontier to Trivandrum. The backwaters are the expansions of the rivers at their mouths, or extensive sheets of water receiving the accumulated flow of several rivers and streams. They are separated from the sea by a bar of sand and silt varying from 7 miles to half a mile in width, with several outlets through which the water is discharged into the sea. The flood tides often overflow the sandbars, raising the level of the backwaters by as much as 2 ft. The total area covered by these backwaters is about 180 sq. miles. The long narrow stretch of sand between them and the sea, as well as their banks, are densely covered with a luxuriant and unbroken growth of cocoanut palms which provide the staple produce of the country. In some parts where there are natural or artificial embankments, there is a vast extent of rice fields. The country lining the backwaters is low and generally swampy, and often liable to be flooded during the monsoon inundations.

Climate: Along the coast the climate is equable and damp; the temperature seldom rises above 90° F. or falls below 70° F. At the foot of the hills, the variations range 5 or 6 degrees on either side of the above. On the hills the temperature varies with the altitude, the climate being generally of a moist temperate region. During the winter months the temperature is sometimes 50° to 70° F. during the day, while frost at night is not unknown.

The rainfall is heavy, the greatest incidence being of the South-West Monsoon between May and September. The country, however, gets considerable benefit of the North-East Monsoon as well. The average annual rainfall is as follows: Nelliampathy Hills 150″ and over; Chittūr (in the Pālghāt Gap) 66″; Trichūr 132″; Ernakūlam 102″; Peermade 200″; Trivandrum 66″; Ashāmbū Hills 80-100″. It varies between these limits according to aspect and physical features of the locality.

The mean humidity of the atmosphere is as much as 70 per cent of saturation at its lowest and about 90 per cent at its highest, contrasting with the minimum and maximum in Coimbatore, just on the eastern side of the Ghāts, which are only 52 and 75 per cent, respectively.

The abundant rainfall and excessive humidity are responsible for effects of climate and scenery which find their parallel in Ceylon. The great difference between the southernmost portions of the Indian Peninsula east of Travancore (Tinnevelly District) and Ceylon which is so near it, and the marked similarity of the island to Travancore and the Malabār zone generally, are a curious feature of Indian physiography. All the physical aspects of the Nilgiris, and the Annemalāis and other Travancore-Cochin ranges are repeated in the highlands of Ceylon.

Forests: The forests of Travancore-Cochin are divisible into four classes, as follows:

1. Heavy moist evergreen, confined to the Ghāts (chiefly the western slopes) and ravines, and perhaps to one-third of the upper hill plateau.
2. Land originally covered with evergreen forest, but now overgrown by secondary scrub jungle of various ages.
3. Deciduous forest with grass growing under the trees, which covers the ridges and the higher ground and a part of the hill plateau.
4. Rock and stony land covered with short grass.

PECULIARITIES OF THE FAUNA OF TRAVANCORE-COCHIN.

As has been observed before by Ferguson (*J.B.N.H.S.*, vol. xv, p. 249) there is a curious but marked similarity between the vertebrate animal life of Travancore-Cochin (in fact of all the heavy-rainfall zone or belt herein treated of under the comprehensive term Malabār) together with the south-western hilly regions of

Ceylon on the one hand, and that of the Himalayas (especially from the east of Nepal to the extreme North-Eastern frontier of British India, and beyond into Yūnnan and Western China), Assam, Burma, Tenasserim, Siam, Malay Peninsula extending often into Java, Sumatra, Borneo and adjacent islands on the other. The same applies to insects and many of the other invertebrate forms as well.

Before attempting to analyse these remarkable affinities and parallelisms in areas often separated by stretches of 1,500 miles or more of intervening country over which the forms are absent, and investigating the causes and factors which may help to explain the origin and continuance of these isolated colonies, it will be necessary first to enumerate some of the more outstanding examples exhibiting these distributional peculiarities.

Among Mammals, the Tahr (*Hemitragus*) and the Marten (*Charronia flavigula*) will suffice.

Hemitragus nilgiriensis: The Nilgiri Tahr, or 'Ibex' as it is popularly misnamed, is found in a section of the hills of South-Western India from the Nilgiris down through the Nelliampathies into the Annemalāis to about 10° N. lat. Over 1,000 miles separate it from the only other Indian representative of the genus viz. *Hemitragus jemlaicus* the Himalayan Tahr, whose range is from Kashmir to Bhutan. A third species, *H. jayakari*, also lives in an isolated colony in the hinterland of Oman (Arabia). These animals inhabit mountainous country with cliffs and precipices.

Charronia flavigula: Found throughout the Himalayas from the Hazāra country to the eastern extremity of Assam at elevations of not exceeding 7,000-8,000 ft., also through the hilly parts of Burma, Malay Peninsula and Sumatra; South China and Amūrland.

In the Peninsula of India this Marten occurs in the higher portions of the Western Ghāts south of the Nilgiris, and in the Travancore ranges. It is also said to be found in the Ceylon hills.

Among Reptiles a prominent example is furnished by the genus of Flying Lizards, *Draco*. It is represented by 3 species ranging from Assam to Yūnnan, down through Tenasserim and Siam to Singapore and probably still farther south into the islands of the Malay Archipelago. A fourth species, *Draco dussumieri*, occurs in Malabār, Cochin and Travancore.

Ixalus, a beautiful little tree-frog, is a notable instance of discontinuous parallel distribution among Amphibians. The genus is found in Borneo, Malay Peninsula, Burma and Eastern Assam. It is well represented (by at least 6 species) in the wet Travancore hills, and probably elsewhere in similar facies in the Malabar monsoon zone.

Coming to our own group, Birds, we find that instances can be multiplied many fold. In the following I have selected some of the more outstanding examples: the species occurring in the Himalayas, Assam, Burma, Tenasserim, Malay Peninsula and Islands, are enumerated first, followed by their representatives living in isolated colonies within the Malabār zone as above limited, and in Ceylon.

Genus *Garrulax*[1]: Laughing Thrushes.

(Forest-frequenting birds, found from the level of the plains up to about 9,000 ft. but usually to 4,500 ft., varying with locality and species.)

Represented within Indian limits by 6 species in 12 geographical races, inhabiting the Himālayās from the Hazāra Country in the west to the North Chin and Kachin Hills on the east; Assam, Cachar, Shan States, Central Burma, Pegu, Tenasserim. Outside our limits, it extends to Yūnnan, Hainan, Siam, Annam, Cambodia, Malay Peninsula, Sumatra, Borneo and other islands of the Malay Archipelago.

An isolated seventh species *Garrulax delesserti* occurs in South India, its distribution being confined to the hills of Wynaad to South Travancore. It is absent in Ceylon.[2] The distance separating *G. delesserti* from its nearest congener in the other areas is 1,000 miles in the Himalayas, and 1,500 miles across the Bay of Bengal in Burma.

Genus *Trochalopteron*: Laughing Thrushes.

(Forest-frequenting birds, found at elevations over about 4,000 ft. They have obviously some biotic connection with the wild Raspberry, *Rubus*,[3] at least in Southern India, the distribution of which plant exhibits parallel peculiarities. In the hills of the Malabār zone *Rubus* is met with only at elevations above 3,500-4,000 ft. Immediately this altitude is reached and *Rubus* appears, *Trochalopteron* may be confidently looked for.)

Represented in Northern India and the Eastern Peninsula by 11 species in 27 races, from the frontier of Afghanistan on the west, right through the Himalayas to the Mishmi Hills and the extreme North-East Frontier, and beyond. (Quetta and Ziarat in Baluchistan, North-West Frontier Province, Chitral, Gilgit, Hazara Country, Murree, Kashmir, Tibet, Garhwal, Kumaon and Simla Hills, Nepal, Sikkim, Bhutan, etc.) The genus is found

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[1] As there is disagreement among different authors regarding the scope of the genus *Garrulax*, it might here be explained that in the above it has been limited as accepted in the *New Fauna*.

[2] It is a matter of opinion whether the genus is represented in Ceylon or not. *Turdoides cinereifrons* of the *Fauna* was formerly reckoned a *Garrulax* and originally named by Blyth as such. Mr. Whistler indeed considers it so extremely close to *Garrulax* that he even compared it with *delesserti* to see if they could be considered subspecies of each other! He himself would prefer to consider it a *Garrulax*.

[3] Of the 41 species of this Genus admitted by Hooker in the Flora of British India, mostly confined to the Himalayas, Assam, Burma, etc., and growing at altitudes of over 3,000 ft., four are recorded from Ceylon. Three of the latter are found in the hills of South India, one, *R. ellipticus*, also occurring from the Western Himalayas to Burma. It is significant that in Ceylon, *Rubus moluccanus* var. *macrocarpus*, contrary to the habitat of the genus descends as low as 1,000 ft. A species of *Oreocincla*, endemic to the island, viz., *O. spiloptera*, contrary likewise to the habitat of its congeners elsewhere, descends in its distribution to about the same low level.

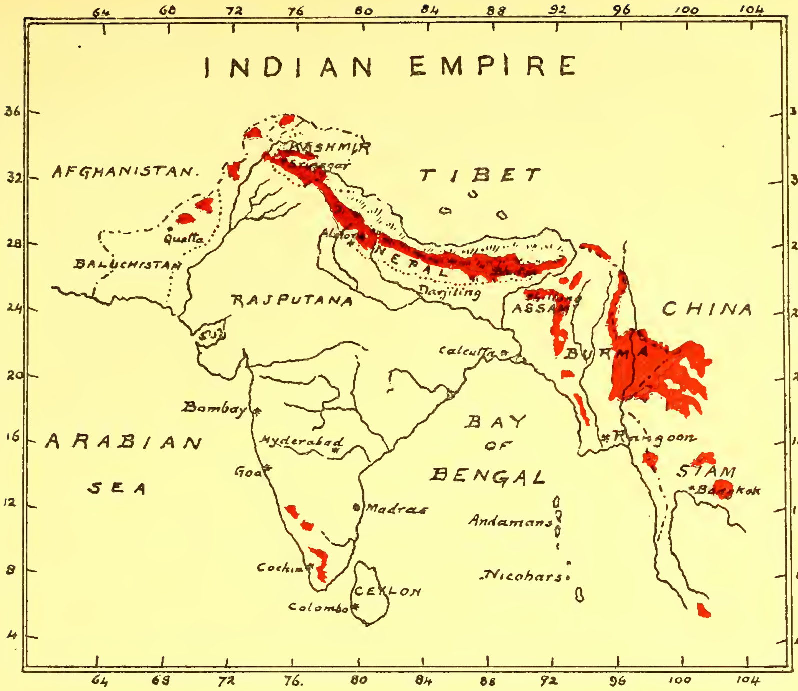
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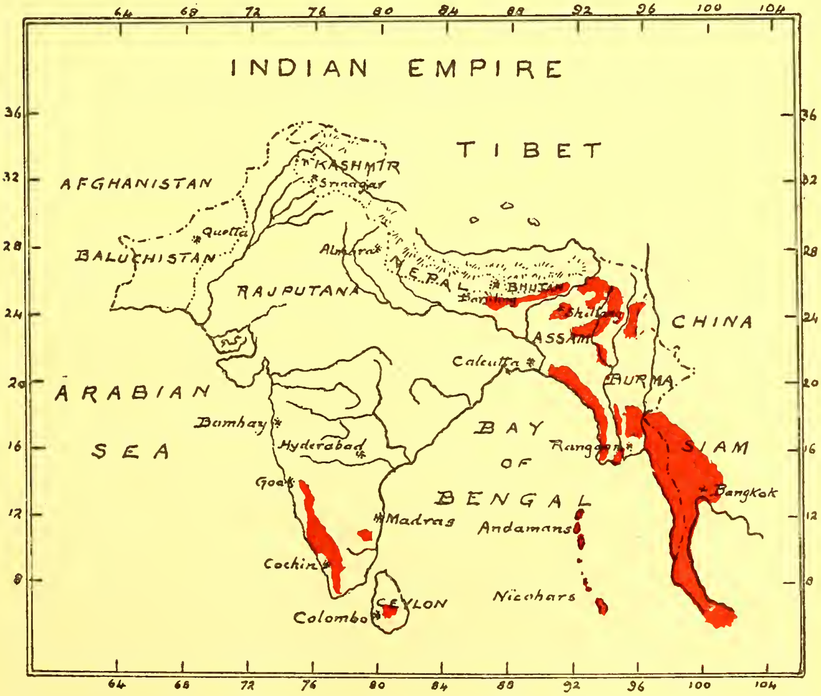
Fig. 1. The distribution of the genus *Trochalopteron* (Laughing-Thrushes) in the Indian Empire.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Calcutta
BURMA
ARABIAN SEA
Bombay
Hyderabad
BAY OF BENGAL
Rangoon
SIAM
Bangkok
Goa
Madras
Andamans
Cochin
CEYLON
Colombo
Nicobars

Fig. 2. The distribution of the Fairy Blue-bird (*Irena puella*) in the Indian Empire.

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in all the Assamese Hills (Dafla, Mikir, Naga, Manipur, Lushai, Khasia) and the Burmese Hills (Chin and Kachin), Arakan, Shan States, Karenni, and down to Muleyit Mountain in Tenasserim.

Beyond Indian limits the genus extends eastward to Eastern China and southward to the Malay Peninsula.

In Peninsular India it occurs in the Malabār zone in 2 species viz. *Trochalopteron cachinnans* and *T. jerdoni*, the former having 2 (? *cinnamomeum* extremely doubtful!) and the latter 3 local races. Its distribution is confined to a section of the Western Ghāts which is almost exactly coincident with the range of the Nilgiri Tahr. Like the Tahr also, it does not extend to Ceylon. (See diagram map.)

Genus *Oreocincla*: Mountain Thrushes.

(Inhabitants of hill-forests and sholas, usually at elevations between 2,000 and 4,000 ft.—often considerably higher in the Himalayas.)

Represented in Northern India and the Eastern Peninsula by 3 species in 5 races, distributed throughout the Himalayas from the Afghan frontier on the extreme North-West, over the Hazara Country, Chamba, Kashmir, Garhwāl and Simla Hills, Nepal etc. to the extreme North-East frontier, and beyond into Yūnnan, Annam and Siam. It also occurs in the Chin and Kachin Hills, North and South Shan States and in the mountains of Central Burma to Tenasserim.

In South-West India it is represented by a race of the Himalayan *O. dauma*, viz., *nilgiriensis*, which occupies the hill ranges from the Nilgiris south to Central Travancore at altitudes between 2,000 ft. and the highest hills. In Ceylon a third race of the same viz. *imbricata*, inhabits the hills from 3,000 ft. up, while another species *O. spiloptera*, found from the level of the Plains up to 4,000 ft., is endemic in the island.

Irena puella: The Fairy Bluebird.

(Typically an inhabitant of evergreen jungles and sholas, from almost the level of the plains to 4,000 ft. or occasionally higher.)

The distribution of this bird within Indian limits, confined to one species and two races, is significant. In North India and the Eastern Peninsula the longer winged race *sikkimensis* is found in the Himalayas from Sikkim and Bhutan to Eastern Assam; the whole of Burma (in the wet forests) and south to the Malay Peninsula (where it intergrades into a third Malayan race *cyanea*) and east into Siam, Annam and Cochin China.

With an intervening break of at least 1,200 miles to Sikkim and of 1,000 miles across the Bay of Bengal to the Andaman and Nicobar Islands the species makes its appearance (in the typical race *puella*) in the Chitteri and possibly adjoining hills of South Arcot and thence westward, presumably through the Shevaroy Hills, into the rainy Malabār zone of South-West India. Here it inhabits the evergreen jungles and sholas of Travancore, Cochin, the

Nilgiri and adjoining ranges, extending northward to Kanara.[1] (See diagram map.)

Genus *Arachnothera*: Spider-Hunters.

(Birds of tropical and sub-tropical rain forests.)

Represented in the Himalayas and the Eastern Peninsula by 4 species in 5 races distributed from the Sutlej Valley to the extreme south and east of Assam, and through Burma, Tenasserim and the Malay Peninsula down into Sumatra, Borneo and neighbouring islands. Also Yūnnan, Siam, Annam, Cochin-China, etc.

The distribution of one species and race, *Arachnothera l. longirostris*, is remarkable. It occurs in eastern and southern Assam, E. Bengal (Tipperah), Chittagong, the hill-tracts from Manipur to the Chin Hills; Shan States and Burma south to the whole of the Malay Peninsula, Siam, Annam and Cochin-China.

After a break of over 1,000 miles from its nearest inhabited area, *A. l. longirostris* re-appears in the extreme south-west of the Indian Peninsula where it ranges from South Travancore, north through the Nilgiri and Palni Hills to the forests west of Belgaum.

Genus *Hemicircus*:

(Small woodpeckers inhabiting dense deciduous forest on the verge of evergreen jungle, i.e., the transition zone between deciduous and evergreen.)

Represented by 2 species in 2 races in Assam, Burma, Tenasserim, Malay Peninsula, Siam, Cochin-China and Annam.

A third race—*Hemicircus canente cordatus*—is confined to the the Malabār zone of S.-W. India.

Genus *Macropicus*: The Great Black Woodpecker.

(Inhabitants of mixed evergreen and deciduous forest.)

Represented by 1 species in 2 races in Burma from Northern Shan States to Tenasserim, Malay Peninsula, Borneo, Sumatra, Java, Bali, etc. A second species—*M. hodgei*—is restricted to the Andaman Islands.

In S.-W. India a third race of the continental species, namely *Macropicus javensis crawfurdi* occurs in the Malabar zone from Travancore to Belgaum.

Genus *Vivia* (*Picumnus*): Speckled Piculets.

(This genus has several species in South and Central America (?) but only a single—*innominatus*—in the Old World.)

The above species, in 2 races, ranges in the Himalayas from Kumaon to Assam, Karen Hills, Shan States, Burma, Tenasserim, Annam, Siam, Malay Peninsula, Borneo, Sumatra, etc.

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[1] There is no record of this species in Khāndesh and it of course does not occur there. The most northerly record in this area is for Sāvantvādi (near Goa) where a single specimen was obtained by Mr. Crawford's shikari (S.F., ix, 65). Butler says that a Mr. Laird obtained it in the 'forests south-west of Belgaum' (S.F., ix, 403) and it is of course common in suitable forests in North Kanara. The extension to Khāndesh is one of the inaccuracies entirely typical of the *New Fauna*.

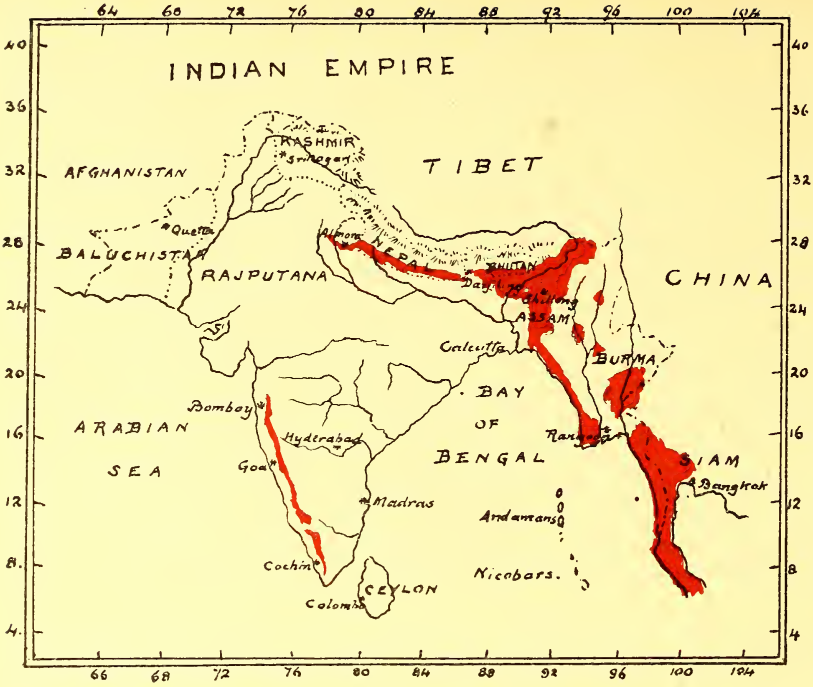
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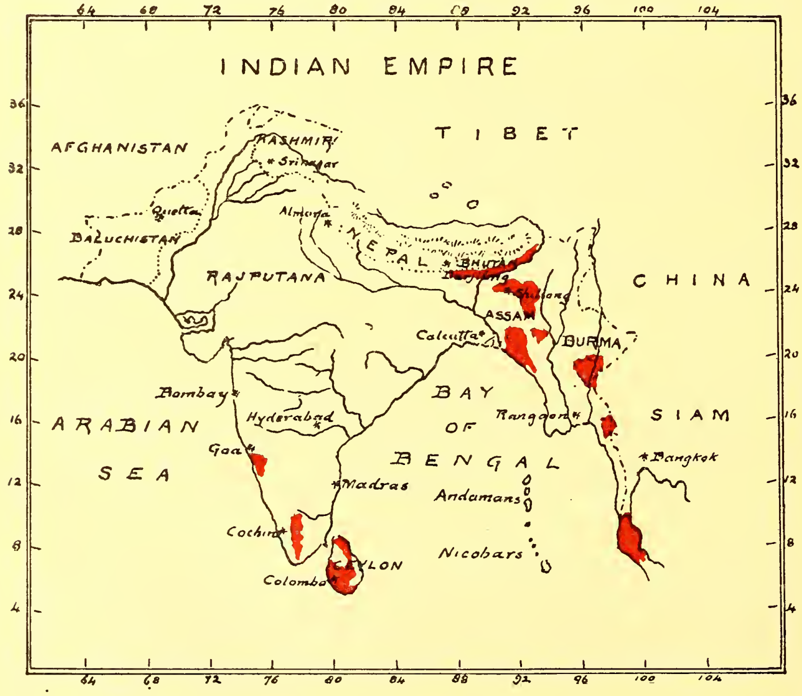
Fig. 3. The distribution of the Great Hornbill (*Dichoceros bicornis*) in the Indian Empire.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SIAM
ARABIAN SEA
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Madras
Andamans
Cochin
Nicobars
CEYLON
Colombo

Fig. 4. The known distribution of the genus *Batrachostomus* (Frogmouths) in the Indian Empire.

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In S.-W. India a third race, *Vivia innominatus avunculorum* (Hartert), inhabits the Travancore, Wynaad and Nilgiri hills and as far north as the Sirsi Taluka of N. Kanara.

Genus *Alcemerops*: Bearded Bee-eaters.

(Birds of rain forest country, up to 5,000 ft.)

Represented by 2 species in the lower Himalayas from Dehra Dun to Eastern and Southern Assam and down through Burma, Siam, Malay Peninsula to Sumatra, Borneo, etc.

One of these species—*Alcemerops athertoni*—after a break in its distribution of well over 1,000 miles, occurs again in S.-W. India (Malabār zone) from Travancore to Belgaum.

Dichoceros bicornis: The Great Indian Hornbill.

(Typically a bird of the tropical and sub-tropical rain forests of Asia.)

Distributed in the Himalayas and Eastern Peninsula from Kumaon to Eastern Assam, Chittagong, Burma (wet portions), S.-W. Siam, Malay Peninsula to Sumatra, Borneo, etc.

Occurs in S.-W. India in the Malabār zone, separated from the rest of its range by at least 1,000 miles of intervening country. (See diagram map.)

Genus *Hirundapus*: The Spine-tail Swifts.

(Residents of rain-forest country.)

Represented by 2 species in 3 races over the Himalayas from the Hazara country to the extreme N.-E. Frontier; hills of Assam, Burma, Malay States and Cochin-China. The genus extends farther to Java and neighbouring islands.

Hirundapus giganteus indicus also occurs in the Malabar zone, an area separated from the rest of its range by over 1,000 miles.

Lyncornis cerviniceps: The Great Eared Nightjar.

(Birds of the lower hill forests, most commonly below 3,000 ft.)

Represented by the typical race *L. c. cerviniceps* in Eastern Bengal and Assam, Burma, Malay Peninsula and S.-W. Siam. Various geographical races of this species (or probably a second also) are found right up to New Guinea.

A race of *L. cerviniceps*, viz., *bourdilloni*, is confined to South and Central Travancore only.

Genus *Batrachostomus*: The Frogmouth.

(Closely allied to the Australian genus *Podargus* which is found over the greater part of the Australasian region. Birds of deep evergreen forest.)

Represented by 2 species in the Eastern Himalayas from Sikkim to the N.-E. Frontier; Assam, Burma, Malay Peninsula, Peninsular Siam, Java, Borneo, etc.

A third species—*Batrachostomus moniliger*—is common to Ceylon and the Malabar zone. (See diagram map.)

Genus *Huhua*: Eagle Owl.

(Dwellers of heavy jungle.)

Represented by 2 species in the Himalayas from Kumaon to Eastern Assam, Burma, Tenasserim, Malay Peninsula, Sumatra, Java, Borneo, etc.

One of the above species—*Huhua nipalensis*—also occurs in the forests of the Malabār zone from the Nilgiris through Travancore to the hills of Ceylon.

Genus *Baza*:

(Birds of deep well-watered forests. Found in Africa, Madagascar, the Oriental Region to Australia.)

1. *Baza leuphotes*: The Black-crested Baza.

Represented by 2 races from the Nepal Terai to Eastern Assam, Burma, Siam, Indo-China and N. Malay Peninsula.

One of the above—*Baza leuphotes leuphotes*—is also found in Travancore and Ceylon.

2. *Baza jerdoni*: Jerdon's Baza.

Represented by the typical race *jerdoni* from Sikkim to Eastern Assam, Burma, Malay Peninsula to Sumatra.

A second race—*Baza jerdoni ceylonensis*—occurs in the Malabār zone and Ceylon.

Besides the above, numerous other examples from almost every endemic family could be cited which exhibit the same distributional peculiarities in a greater or lesser degree. Some of these are: *Microscelis*, *Eurystomus*, *Alcedo meninting*, *Ceyx tridactylus*, *Sauropatis*, *Anthracoceros*, *Collocalia*, *Phodilus badius*, *Ninox scutulata*, *Ictinaëtus*, *Spizaëtus*, *Accipiter virgatus*, *Ducula badia*, *Muscadivora*, *Chalcophaps*, *Gorsakius*.

To the question of the origin of these isolated South Indian and Ceylonese colonies we shall revert later. In the meantime let us first consider, one by one, the factors that seem most important in giving rise to and maintaining the parallel environmental conditions which conduce to the existence of so many specialised forms in such widely sundered areas.

GEOLOGY.

Some general remarks on the Geology of India seem called for in order to convey a proper idea of the physical features and their resultant effect upon the meteorology of the country, particularly of the tracts here concerned.

Peninsular India is an example of a solid land mass which has neither been folded nor disturbed since the earliest geological times. South of the Gangetic 'Valley' and of the Vindhyan Range, the country, except for some places near the coast-line, has not been under the sea. Its orographical features therefore, are merely the outcome of differential erosion. The square-cut, deep-sided hills of the Deccan proper, composed of horizontal layers of lava flows, are of what is known as the 'relict' type, caused by the toning down of intervening portions of a once continuous plateau by long exposure to the weather. The shallow open valleys, with rivers near their base level of erosion, and the gently undulating plains are all the result of this process.

In contrast with this stable land mass of the Peninsula proper, the extra-peninsular area, i.e., the land lying to the west, north and east of the Indo-Ganegtic alluvial plain (viz., Sind, Baluchistan, the Himalayan Mountain belt, North Assam and Burma) provides abundant evidence of repeated submergence beneath the ocean, marine fossils being in some cases found as high up as 20,000 ft. above sea level. The Himalayas are the result of the folding of the Earth's crust and its elevation due to pressure from the north, during the latest geological period.

After the Palæozoic era, and during the secondary stage of elevation, while ocean currents swept from the Persian Gulf to the Aravalli Hills (the oldest of all Indian physical features), the rock area of the Peninsula extended over Assam and the Eastern Himalayas, while Burma, the North-West Himalayas and the uplands beyond the Indus were still submarine or undergoing alternations of elevation and depression. The North-West Himalayas, Tibet and Burma were gradually upraised and fashioned during the epoch at the close of the Cretaceous period; but there is evidence to show that Burma is a much more recent geographical feature than the North-West Himalayas which were formidable mountains even in Pliocene ages. The Andamans and Nicobars have been isolated from the Arakan coast by submergence at a probably recent date.

Geological science inclines to the opinion that the elevation of the Western Ghats to present altitudes was comparatively recent. The steep-sided narrow valleys where the streams are still cutting their way back to their sources and gradually working their beds down to a permanent level, appear to be in the same stage of development as those of the extra-peninsular region. One result of this process of evolution has been that nearly all the great rivers of South India take their rise in the Western Ghats and flow across the continent to the Bay of Bengal. The Nerbadda and Tapti alone cut their way in deep channels westward, and there are indications further south that a great third river may once have found its way to the Indian Ocean across the continent through the Pālghāt Gap. The inference drawn by geologists from the general distribution of the hydrographical features of India seems to be that the peninsula as we now know it, is but the eastern half of a far wider land area of which the main waterparting was nearly if not absolutely coincident with that of the Western Ghats, and that the rivers flowing westward therefrom have disappeared with the land which they intersected.

The geological history of Travancore is the same as that of the rest of the Madras Presidency and the greater part of Ceylon. This is also the case with Tenasserim, most of the rocks found there being similar to those met with in Travancore and the Madras Presidency.

Investigations in other parts of the Globe, viz., Africa, Madagascar, Australia, and even South America, have brought to light an exactly parallel group of continental formations exhibiting much the same physical as well as organic characters (Gondwāna System). It is argued from many palaeontological discoveries in the Cretaceous Systems of Africa and India that an unbroken land connection existed between these regions, across what is now the Indian Ocean, in a large southern continent which extended from West Africa to Ceylon and South India and possibly united within its boundaries the Malay Archipelago and Australia as well. The presence of such terrestrial mammals as the *Lemuridae* in the Indo-Malayan Region on the one hand and in Madagascar on the other, seems difficult to account for in any other way, and is generally cited as one of the proofs for the existence of a land connection sufficiently continuous to bring about the present peculiarities of distribution. It is postulated that the intervening land mass has since subsided under the ocean, the submerged Indo-African continent being termed Lemuria.

There is also a certain amount of typically Indian element in the avifauna of Madagascar which seems to have been severed from Africa even in the early Tertiary epoch. Sedentary forms such as *Copsychus*, *Microscelis* and *Ninox* may be considered as undoubted examples. In Mauritius the incursions of the Indian avifauna appear to be *Collocalia*, and *Palaeornis* (*Psittacula*) while in the island of Réunion, the parrot *Mascarinus* possesses undoubted affinity to our Indian *Psittacula*. The presence of all these forms lends further support to the theory of the Lost Continent.

The bird-life of Africa is now cut off from that of India by the arid belt of North Africa which stretches across Arabia and Baluchistan to Sind and Rajputana. There is overwhelming evidence that both these regions were once connected by a forest belt which permitted an exchange of forms. Presumably Africa got the following in this manner: *Bucerotidae*, *Eurylaemidae*, *Treronidae* and the genera *Palaeornis* (*Psittacula*) and *Pitta*, furnishing in return *Indicator* and *Salpornis* (**13**, p. 656).

It was in the early Tertiary or the end of the Cretaceous period that Gondwānāland (which included Lemuria), the most prominent feature of the Earth's Mesozoic geography, finally broke up and the Peninsula of India acquired its present restricted form. Incidental to this change a profound redistribution of land and sea took place in the Southern Hemisphere. Few geographical changes of any magnitude have occurred since these events and the triangular outline of South India acquired then has not been altered since to any material extent.

While there is little in the geological history of the Malabār zone on the one hand and the areas to which its fauna so closely approximates on the other to suggest any *direct* influence of this factor in the existence of such convergence, yet it is undoubtedly the geological movements and evolution that are responsible for producing physical features which, by regulating meteorological conditions, have produced parallel environments adapted to the existence of peculiar and parallel forms of life in these widely sundered areas.

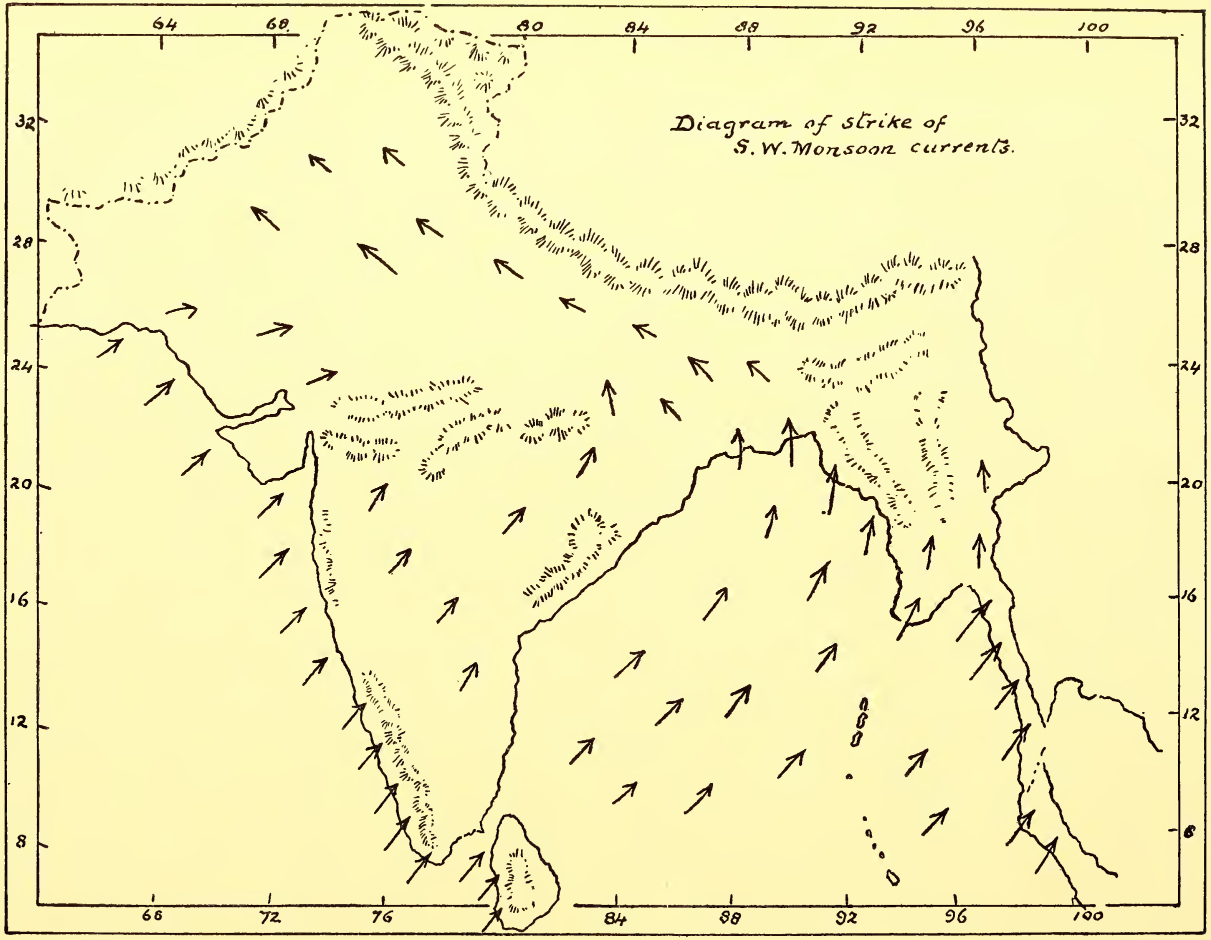
Diagram of strike of
S.W. Monsoon currents.
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Map to illustrate the strike of the S.W. Monsoon currents in the Indian Empire.

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METEOROLOGY.

The physical and geographical features of India are of great importance in so far as they modify more or less considerably the lower air movement, and hence the distribution of temperature, humidity and rainfall.

Its northern districts are more excessive in climate than the southern because they are broader expanses of land, and the western side of the Peninsula is more equable than the eastern because it is much more humid. The great extent and elevation of the high land in South Ceylon powerfully influences the meteorology of the whole island.

For our purpose it will suffice to consider only the conditions that produce the excessive humidity and heavy rainfall common to the tracts under discussion, for as is well known, the principal factor which regulates vegetation is rainfall, the quantity and distribution of which, controlled by the physiographical characters of the locality, decide to a great extent the nature of its most important plant formations. Analysis shows that it is the similarity of the physical features of the Malabār zone and of S.-W. Ceylon on the one hand, and those of the Eastern Himalayas, Assam. Burma, Tenasserim, Malay Peninsula and Archipelago on the other that is primarily responsible for producing more or less parallel conditions of climate.

By far the greatest amount of rainfall is precipitated during the South-West Monsoon. The heated atmosphere over the Indian land mass and beyond in Central Asia ascends during the hot season giving rise to a low pressure area which is rapidly filled by oceanic air currents from the Arabian Sea and the Bay of Bengal, of great volume and elevation and heavily charged with aqueous vapour. One of the main causes that determine the distribution of rainfall during the season of the South-West Monsoon (May to September) is ascensional movement due to forced ascent across natural barriers. Such forced ascent across or against hill-ranges into the cooler and higher atmospheric strata enveloping the heights results in condensation of the moisture-laden vapour and produces heavy rainfall in (*a*) Malabar, the Konkan and Gujerat (?); (*b*) Ceylon; (*c*) Tenasserim and Arakan; (*d*) the Assam Hills and Sylhet, the lower Himalayas and submontane districts, more especially in the eastern half. The portion of the Himalayas west of about Sikkim is not exposed to the full burst of the annual monsoon currents. The Bay current advances towards them, but is deflected, and though there is much ascensional movement, it is not forced ascent accompanying movement across the line of hills. Hence the distribution of the rainfall here does not follow the same law as in the Western Ghats or the Assam Hills, neither is it on the whole so heavy.

The North-East Monsoon (November to January) which produces rainfall of considerably less extent, also reacts to the hill ranges of Assam, Burma, Ceylon and South India in the same way. It is caused by the high-pressure system which develops in Central Asia at this season and the consequent outflow of the cooled air towards the Equator. Travelling over vast spaces of dry land it is not charged with much moisture. Such rain as falls at this period in the North-Eastern parts of India is mainly the result of the driving back against the mountain barriers of the moisture-laden winds of the South-West Monsoon that have escaped undischarged. A certain amount of moisture is collected by the winds in travelling over the Bay of Bengal, and the winter rains in the Southern part of the Peninsula are due to this. On the Pālni, Nilgiri, Annemalāi and other Travancore and Cochin Hills the amounts registered during the months from October to December are about two-thirds of the fall received during the last 2 months (August and September) of the South-West Monsoon.

We find, therefore, that climatologically the Malabār zone, Ceylon, the Malay Peninsula, Tenasserim, parts of Burma, the Eastern Himalayas and Assam present very similar features as regards the Monsoons especially the South-West which is by far the more important of the two. On account of the similarity of physical features and relative geographical position, the South-West Monsoon currents strike the seaward faces of all their hills directly and all these areas consequently receive heavy rainfall at that period. (See diagram map.)

VEGETATION.

The distribution of a flora depends chiefly on geographical and climatal features, especially rainfall and humidity. Plant formations, besides, are also influenced by aspect, by the composition of the soil and by the depth of the permanent sub-soil water supply, all of which influences account for the appearance of species (covering it may be large areas) in zones generally deemed unsuitable to their growth.

In the previous section it was seen how similarity in physical features and geographical situation has combined to influence the main factors in the meteorology of the widely separated areas under consideration, and to give rise to the moist and humid conditions common to all of them. It now remains to analyse some of the more outstanding features in the vegetation of these areas to see whether, and how far, the similarity in climate has resulted in discontinuous but parallel distribution of plant formations and associations.

The abrupt western face of Malabār, especially towards the south, is clothed with a luxuriant forest vegetation in which there is a marked preponderance of Malayan types over those of the adjoining Deccan area. Travancore and Cochin, isolated by natural barriers, present a remarkable similarity to Ceylon in position and many features of topography, climate and vegetation. The botanical featues of the island, as may be expected, coincide with its physical. The moist mountainous southern and south-western districts have a flora of the Malabār type though showing even more Malayan affinities, and the hot dry northern districts one of the Coromandel type. It may be mentioned here that there is a marked resemblance between the northern districts of Ceylon and those of Madras east of the Malabār Ghats (viz. Madūra and Tinnevelly) on the one hand, and Egypt on the other. The umbrella-shaped *Acacia planifrons*, confined in India to the above districts, is common to both these regions while the prevalence of *Cocculus Leaeba* and *Capparis aphylla*, the production of fine cotton and the best Senna (*Cassia obovata* and *C. angustifolia*) enhances the similarity.

Though tropical Asia and Africa are now separated by a vast expanse of ocean, there is a striking similarity in their vegetation, both in the annual forms that spring up during the rainy season and in the families and genera of trees and shrubs, e.g., *Capparis, Grewia, Sterculiaceae, Acacia, Rubiaceae*, etc.

Densely wooded gorges known as *Sholas*, similar to those of the Nilgiris, occur in the Annemalāi, Pālni and other ranges of the Malabār Ghats south to Travancore and also in the highlands of Ceylon. These sheltered and wooded dells, which are a feature of the Khāsia and other Assam and Burma hills as well, possess a vegetation which closely resembles that of similar spots in the Eastern Archipelago and contain many representatives of the Malayan flora such as *Ternstrœmiaceæ, Rhododendron arboreum, Vaccinia, Gaultheria, Symplocos, Michelia, Goughia* and *Gomphandra* which seem equally frequent at analogous elevations.

Notwithstanding the enormous precipitation and great humidity the upper parts of the Nilgiris, Travancore-Cochin and other South Indian hills, as well as those of South-West Ceylon, are characterized by the presence of expanses of open undulating grassland, generally bare of trees. This curious anomaly is due partly to the nature of the surface and the free drainage, but mainly to the removal of the soil by the heavy rains and to the furious winds which sweep over the level tops of the hills. It is a feature that is also repeated in the Khāsia and other hills of Assam.

The most interesting feature of the Nilgiri flora as a whole and that of the Malabār Ghats and the Ceylon hills, is its affinity with the cool regions of the far distant Khāsi, Manipūr, Nāga and other hills of Assam and North Burma. Many trees and shrubs are common to these two localities, and most of them to the temperate Eastern Himalayas as well. The herbaceous plants are particularly numerous. Hooker and Thomson (**7**, p. 104) remark: 'Constantly during our examination of the temperate as well as the tropical plants of the Nilgiri, Khāsia, Ceylon and the Himālayā, we find them identical in species with Javanese mountain plants. . .' 'Besides *Gaultheria nummularia* found in the Javanese mountains but extending from N.-W. Himalayas along the whole Himalayan range and in the Khāsia Mountains; also probably in the mountains of the Malay Peninsula and of Sumatra (over 3,000 miles), there are many other Java plants spread over the hilly districts of India and Ceylon.'

Enough has been said to show that the great similarity in the areas under consideration (namely Malabār zone, Ceylon, the Eastern Himalayas, Assam, Burma, Tenasserim, Malay Peninsula, Sumatra, Java, Borneo and probably farther east) though often widely separated, is not merely a haphazard circumstance but based upon an obvious and demonstrable concatenation of ecological conditions brought about by analogous natural causes. It is not surprising therefore, that scrutinized further, the links in this symbiotic chain should be found to be equally well-forged. The similarity of physical features accounts for more or less identical climatic conditions, which in turn are responsible for parallelisms in the vegetation. Similarity in plant-life conduces to a similarity in the insect forms dependent upon it, while these again have similar hosts predatory on them, and so on through divers ramifications *ad infinitum.*

It has hitherto been believed that the distribution of bird-life was controlled directly by climatic conditions, but we now begin to realize that it is not so much the bird itself but its most important vegetable or animal food that is dependent upon such conditions. The distribution for instance of the kingfisher *Alcedo atthis* on its northern boundary is controlled by the winter isotherm which precludes the possibility of its obtaining fish food in the frozen rivers and streams of Northern Siberia. We also realise now that many species of birds are wholly dependent for their distribution upon the distribution of particular plant-formations and animal associations.

While it is clear that the existence of homogeneous animate forms in widely sundered areas is explainable by a careful scrutiny of analogous natural conditions, the *origin* of their presence in such isolated colonies as those in Travancore-Cochin and Ceylon on the one hand and in the Eastern Himalayas, Assam and Burma hills or Tenasserim on the other must be sought directly in the geological history of the Earth.

ORIGIN OF DISCONTINUOUS PARALLEL DISTRIBUTION.

Hooker and Thomson (**7**, p. 37) are of opinion that 'the majority of the many plants common to the Himalayas and Java, migrated over continuous intervening land which has been broken up by geological causes, chiefly subsidence; just as the partial subsidence of Java itself would effect a further dismemberment of the area now continuously peopled with plants, and which would result in a cluster of islets having a vegetation in common. Extending this idea of submergence and emergence of land, one island may at different epochs have been continuous with different continents from all of which it may have received immigrants.' They do not deny the active agency of wind and animals in aiding distribution and also of oceanic currents to a limited extent, but between some of the present-day isolated colonies the distances are so great that the above seems to be the more plausible, and certainly the more wholesale, explanation.

Meinertzhagen (9) is also of the opinion that the present-day patchy distribution of the genus *Rhododendron* in such widely separated areas as the Himālayās, the hills of Ceylon and Malabār, the Malay Archipelago and Queensland can be satisfactorily accounted for only on the assumption that at one time its distribution was more or less continuous (possibly in distributional waves) to the limits of its present range. The same explanation would also hold in the case of the genus *Rubus* which, as I have suggested above is more or less coincident in its range with *Trochalopteron.*

As regards animals such as the Nilgiri Tahr and Marten among Mammals and the genera *Garrulax* and *Trochalopteron* among Birds, and indeed all the peculiar rain-forest forms above named, as well as the forms common to Africa, Madagascar, India, Malay Peninsula and Archipelago and elsewhere, the origin of their present-day colonies seems most satisfactorily explainable only by the theory (based on good geological and palaeontological evidence) of their being relic colonies of a former extensive and continuous distribution, the intervening population having disappeared owing to adverse competition either climatic or physical.

SUMMARY.

1. Geological action has produced similar physical features in the widely separated areas under reference.
2. Owing to the similarity of their relief and geographical position relative to the strike of the South-West Monsoon currents, they are all areas of heavy rainfall and great humidity.
3. The homogeneous nature of the flora which—through subsidiary ramifications such as the attendant insect-life and other symbiotic inter-connections—must be considered the final determining factor, accounts for the homogeneous nature of the avifauna resident therein.

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ITINERARY AND ECOLOGICAL DATA OF AREAS WORKED.

In the following pages I have been at special pains to record as accurately as possible the topography and ecological features of the areas worked by the Surveys, the rough data for which were actually obtained on the spot. This necessitated the collection of a large number of characteristic plant specimens and those that appeared in any way to influence or be influenced by the local bird-life, for the identification of which material I am indebted to Mr. C. McCann of the Bombay Natural History Society and Mr. K. Biswas of the Calcutta Herbarium.

With the universal recognition of geographical variations and their crystallization into local races or sub-species, coupled with the refreshing tendency in recent years towards breadth in the handling of biological problems, it is obvious that greater precision than heretofore in statements concerning the distribution of animal-life has not only become increasingly desirable but a positive necessity if the utmost scientific value is to be extracted from records and specimens. When working such a physically complex region as Travancore-Cochin it becomes evident how important is the study of ecology, i.e., of the connection between organisms and their animate and inanimate environment, and how misleading the use of loose generalisations in describing the distribution of animal forms. To one unacquainted with the divers aspects of relief and vegetation obtaining within such a comparatively small tract of country the occurrence, apparently side by side, of two such forms as *Dichoceros bicornis*—essentially a bird of tropical and sub-tropical evergreen forests—and of, say, *Eremopterix grisea*—usually associated with barren wastes—would seem anomalous. Instances of this kind of incongruity are for ever obtruding themselves on the critical student throughout the *New Fauna* volumes. Loose statements like 'the whole of Burma', 'Assam', 'Ceylon' or 'Travancore' are there common, and when applied to such specialised and narrowly restricted forms as the above, without any relative ecological data, they only mean confusion.

Careful and rational field-work on species in their natural environment is the *sine qua non* for the study of Bird Ecology, which is clearly a subject that can best be taken up by enthusiasts resident in the country. It is a virgin field and every student with an observant eye and an enquiring mind can make some contribution to the study, howsoever small and seemingly insignificant. A great many biological puzzles await solution by intensive ecological study and it is a line of research that may now be recommended to workers in India as being of far greater importance and potentialities than the mere collection and labelling of skins.

Barring restricted areas and particular groups which still require careful collecting and working out, we can now claim to have a sufficiency of dead ornithological material from India in the great museums of the world to satisfy the needs of even an exacting taxonomist. Most bird-lovers in this country possess neither the inclination, training nor facilities for making any substantial additions to our knowledge of systematics. Speaking generally, therefore, Indian systematic ornithology is best left in the hands of the specialist or museum worker who has the neces-

A Panorama of the Cardamom Hills, Santhanpāra.

Photos Author

A Cardamom Plantation (Santhanpāra)
A Favourite Bird Haunt.

Photos *Author*

" Eeta " (*Ochlandra travancorica*), facies of the jungle at Thattākad.

Typical moist evergreen forest, Thattākād, where the only 2 specimens of *Batrachostomus moniliger* were obtained.

sary material and facilities at his command. This is not by way of disparagement to workers in India; far from it. But the point must be stressed that workers in India are in a position to contribute to the solution of the many problems in a different, but by no means less important, way, i.e., by intensive inductive and deductive field observation of a rational kind, an investigation denied to the musem worker abroad. My plea therefore is merely for division of labour.

I hope to be able in a subsequent paper to make some suggestions which may help to obviate the existing generalisations in distributional terminology, so often misleading. The first desideratum is to classify and define different biotopes and facies such as Evergreen Forest, Sandy Desert, etc. on the strength of easily recognisable characters. Isozoic tracts or units inhabited by similar forms of life (such as are dealt with in this paper) might be appropriately named after their most salient features, vegetable or animal, and the distribution of animal forms expressed in terms of these.

In the course of this paper I have frequently made use of the terms *Biotope* and *Facies* in describing the habitat of birds. The latter differs from the former in the same way as race from species i.e. a Biotope may be split up into several Facies. Just as Species rise into Genera, and these in turn into Families, Suborders and Orders, so can Biotopes be arranged according to their affinities into higher groups and these again into still higher units. Some excellent suggestions are given by Hesse in his *Tiergeographie* (**5**).

TRAVANCORE STATE.

1. **Māraiyūr,** alt. ca. 3,500′—3-15 January, 1933.

In North Travancore, ca. 10°17′ N. × 77°10′ E., 11 miles south of the frontier station of Chinnār.

A valley among high hills of the Ānnemalāi range, which here rise to over 8,000 ft. There is extensive paddy cultivation throughout the length and breadth of this valley, which, on account of its hilly nature, has to be terraced into small fields of irregular shape, coincident with the contours of the slopes. Paddy is also cultivated higher up in the hills in terraced fields. One of such hillmen's settlements is Kūdakkādū, about 4 miles from Marāiyūr and at about 4,000 ft. elevation.

Intersecting these terraced fields are numerous hill nullahs of which the perennial ones supply the irrigation for them. The sides of these nullahs, especially higher up, are heavily overgrown with bushes and scrub of every description in which the prickly wild 'Raspberry' (*Rubus ellipticus* Smith) predominates, often rendering the growth impenetrable. The larger perennial nullahs have boulder-strewn beds and are bordered by strips of varying width of evergreen jungle.

Immediately surrounding the little village and camp shed, the country is deciduous scrub-and-bush where Lantana predominates. *Zizyphus oenoplia* also occurs sporadically. It was only in this little patch that *Pycnonotus luteolus* was met. In the vicinity are a number of dense Sandalwood Reserves planted by the Forest Department, this locality being especially suited to the growth of the plant.

Many of the surrounding hills have their higher slopes and tops of bare sheet rock with sparse coarse grass and shrubs springing from hollows and crevices where sufficient soil has accumulated to afford roothold. The hills up to about 4,000 ft. are clothed in mixed evergreen and deciduous jungle, alternating with open patches of coarse grass and dwarf *Phoenix* (*farinifera* ?)

clumps. Lower down, on the slopes rising from the valley, Bamboo (*Dendrocalamus strictus*) with culms up to 3 in. in diameter and 30-40 ft. high, preponderates.

Above 4,000 ft. the bare slopes alternate with patches of evergreen sholas growing in damp ravines. These sholas are a characteristic feature of the landscape here as they are elsewhere in the Nilgiris and other South Indian Hills. They are composed mostly of evergreen trees of comparatively small size with rounded crowns and have a rich undergrowth in which species of *Strobilanthes* are well represented. Among the more characteristic trees are: *Michelia nilagirica, Ternstroemia japonica, Eurya japonica, Gordonia obtusa*, species of *Eugenia, Ilex, Meliosma, Euonymus, Symplocos* and various Lauraceae.

The temperature ranges from 56°-78° F. The rainfall averages 58·5 inches per annum and the locality, except in winter, is notoriously malarious.

2. **Mūnnar,** alt. ca. 5,000′—16-20 January, 1933.
(10°5′ N. × 77°4′ E.; ca. 15 miles S.S.W. of Marāiyūr.)

The centre of the tea-planting district in the Kanan Dēvan Hills (the northernmost section of the High Range) within the concession of the Kanan Dēvan Hills Produce Co. Ltd. This concession, about 1,37,000 acres in extent, has been in existence for about 60 years with the result that the hilly country for miles around has been cleared of all forest and planted over with tea, with *Grevillea robusta* and *Erythrina lithosperma* for shade. Large patches have also been planted with a species of Eucalyptus for fuel. With the absence of forest, there is a marked paucity of bird-life, and such as there is, is mostly confined to the scrub jungle in ravines and bordering the streams that run through the tea estates. These scrub patches consist for a great part of *Rubus ellipticus* Smith and Eeta Bamboo (*Ochlandra travancorica*). Two of the commonest shrubs in these associations are: *Trema orientalis* Blume, generally by streams and nullahs, with berries largely sought after by *Turdus, Carpodacus*, etc., and *Maesa perrottetiana* D.C. whose white berries are a favourite of *Trochalopteron, Carpodacus* and other birds. Average annual rainfall 153″.

3. **Santhanpāra,** alt. ca. 3,500′—22-31 January, 1933.
(ca. 15 miles S.S.E. of Mūnnār; 9°58′ N. × 77°13′ E.)

In the Cardamom Hills section of the High Range, about 6 miles distant from the ridge which marks the boundary between Travancore State and Madūra District of Madras. The country here is very hilly. The higher slopes and tops of many of the hills are devoid of forest, being clothed with coarse grass, the bareness being here and there relieved by patches of evergreen shola, mostly in the ravines. The hills to the N.-E. of the camp-shed are heavily covered with evergreen forest mostly thinned for cardamom cultivation which is here practised on an extensive scale. This is ideal bird country; one can walk long under the canopy of the lofty trees for miles, and the visibility is as good as in a park. The forests contain gigantic trees often over 100 ft. high and of enormous girth, many of them being buttressed. *Cullenia excelsa* with its spiny fruit resembling miniature Durian (*Durio zibethinus*) is one of the commonest species, *Mesua ferrea* being another. Gigantic dammer trees (*Canarium strictum*), with outwardly flaking bark, are frequent. Some of the other common species are: *Vateria indica, Calophyllum tomentosum, Hopea parviflora* and *H. Wightiana, Dysoxylum malabaricum, Acrocarpus fraxinifolius, Artocarpus hirsuta* and *Hydnocarpus Wightiana.* Many species of *Ficus* occur, affording sustenance to numerous birds. Bamboos, except *Ochlandra travancorica*, are practically absent. The latter is found growing in dense thickets on the banks of streams, but more plentifully higher up on the hills about the upper limit of cardamom cultivation (4,500 ft. or so). In scrub patches on the outskirts of evergreen jungle *Rubus ellipticus* is plentiful. In association with this are usually found *Triumfetta rhomboidea* Jacq. and *T. pilosa* Roth., *Solanum verbascifolium* L., and *Polygonum chinense* L. whose slaty black berries are largely eaten by Bulbuls and other birds. Bracken also grows freely among the scrub. The lower hill-slopes are covered with dense clumps of coarse elephant grass often over a man's height, sprinkled here and there by thin scraggy trees of *Grewia villosa* Willd. or *Phyllanthus emblica.* This facies is generally more or less bare of bird-life; only near the tops of the hillocks where the grass is often short (and now burnt) and interspersed with outcrops of sheet-rock, are there any pipits and larks, albeit scarce.

On a hill-top above cardamom cultivation, at ca. 5,000 ft. (Kallipāra) there is a small perennial tank in a hollow, about 100 yds. × 50 yds. called Noolamkūlam. The hill-tops round this place are covered with sparse evergreen forest with tall straight seedlings often over 7 ft. high, and an undergrowth of *Strobilanthes.* A good deal of Eeta Bamboo is also met with here in patches that are almost impenetrable. The trunks and branches of the forest trees are heavily covered and hung with moss. The only birds met with here were *Trochalopteron j. fairbanki, Acrocephalus dumetorum, Pellorenum ruficeps granti* and *Sitta frontalis.*

Around the cardamom store-sheds and coolie-lines which are dotted about the forest, Bananas grow luxuriantly, their flowers being in regular attendance and most probably fertilised by *Arachnothera longirostris.*

The temperature ranged between 56° and 80° F. The average annual rainfall is 74·2″.

4. **Thattākād** (Thattā = plains, kād = forest), alt. ca. 200′—2-13 February, 1933.

(ca. 10°7′ N. × 76°41′ E.; on the left bank of the Periyār River.)

The forest which is principally confined to the right bank of the river, consists in patches of both deciduous and tropical evergreen with frequently a mixture of the two. The commonest species in the evergreen are *Terminalia paniculata* and *T.* (*chebula* ?), *Calophyllum tomentosum, Artocarpus* and species of *Pterocarpus, Cedrella toona* (?) and *Mangifera indica.* Among these are often intermixed Teak, Ironwood (*Xylia xylocarpa*), *Dipterocarpus, Albizzia,* etc. The evergreen undergrowth consists of a good deal of rattan (*Calamus*) and many prickly species of which *Acacia concinna* DC and the 'Incha' (*Acacia intsia*) a sprawling and climbing species with recurved thorns, are perhaps the most plentiful and troublesome. They also occur abundantly in scrub growth on the outskirts of forest. Many of the trees in secondary jungle are thickly-draped and festooned with their tangles. A feature of the evergreen jungle is the fern-like creeper with longish drooping leaves, *Stenochlaena palustre* L. and the wild pepper vines, both of which climb up the tree-trunks to great heights. The prickly climber *Mezoneuron cucullatum* W. & A. var. *grandis* thickly drapes the trees in secondary evergreen patches here as at Santhanpāra. Its yellow flowers are regularly probed into by Sunbirds, Spider-hunters, White-eyes and Chloropses.

On the right bank of the river also, there is a series of plantations of the Forest Department: Teak, Rubber and *Bombax.* The first is about 6 years old, mostly devoid of undergrowth and poor in bird-life. The rubber is about 25 years old, but owing to default of the contractor the weeding has not been done for some years with the result that Lantana, 'Incha' and a host of other species have overrun the place in impenetrable denseness. This area is the best of the three as regards birds. The *Bombax* plantation (25 acres) is only a year old and little more than a forest clearing so far. When the trees are old enough to flower, this place will become a paradise for the bird-watcher. In the *Bombax* clearing may always be seen *Hirundo, Indicapus, Merops, Melittophagus, Coracias, Eurystomus* and *Dicrurus,* while in the Lantana and scrub separating the clearing from the forest are met *Acrocephalus dumetorum, Phragmaticola, Prinia inornata* and *Franklinia.*

In the Government Rubber Plantation and adjoining forest there is a great deal of *Erythrina lithosperma* now in flower (with foliage on), which are visited by innumerable species, especially by hundreds of Lorikeets all day long but chiefly in the mornings up to 11 o'clock or so. Among the other visitors the most regular are Parakeets, *Sturnia malabarica, Dicruridae, Dendrocitta vagabunda* and *D. leucogastra, Arachnothera* and *Leptocoma.*

In the evergreen forest there is a sprinkling of gigantic trees with enormous straight boles often 70-80 ft. to the first branch. The undergrowth consists of seedlings with sparse *Calamus* brakes, lianas, creepers and fallen brushwood. In places the ground is dank and almost marshy.

On the left bank of the river, upstream, and about ½ mile distant from the camp-shed, commences the Palamāttam Rubber Estate (about 900 acres) which stretches along the river almost up to Neriāmangalam. It is fairly well-weeded and is on the whole poor in bird-life except for woodpeckers which fly about among the tree-trunks. Beyond the rubber belt is paddy cultivation, flanked by fairly open deciduous jungle which in places degnerates into stony undulating grassland.

About four miles downstream, on the left bank of the river, open undulating and stony grassland is met, with sparse deciduous shrubs. The dry nullahs intersecting the undulations are heavily clothed in scrub. *Lantana, Triumfetta, Acacia incia* etc., intermixed with tall elephant-grass. It is the typical deciduous country of many places on the Deccan Plateau and here, for the first time in Travancore, were also met *Mirafra* and *Saxicoloides,* so common in the Deccan.

Along the banks of the Periyār River, and those of the many small streams that flow into it, are dense clumps of Eeta (*Ochlandra travancorica*) and they are likewise often lined with 'Omé' trees (*Trema orientalis*) whose berries are a great attraction to all frugivorous birds.

The river here for a considerable distance, runs in a succession of shallow rapids. All along there are numerous diminutive islets in its beds often merely a couple of smooth rounded moss-covered stones on which clumps of Cyperaceae grow. On the mud-banks in the middle and at the sides there also grows much *Phyllanthus Lawii* (?) or some similar sort of 'tamarisk'.

No water-birds were seen except kingfishers, *Ardeola grayi*, *Anhinga melanogaster* and *Motacilla madraspatensis* which were usually present in small numbers.

The country hereabouts is stiff with Wild Elephants and bird-collecting often provided unexpected thrills!

Thattākād principally gets the S.-W. Monsoon, but a few falls of the N.-E. Monsoon are also received. The average annual rainfall is about 141·5".

On 4 February, the following temperatures were recorded: 6-30 a.m., 70° F.; 4 p.m., 90° F.; 8 p.m., 80° F. The humidity is great.

5. **Kottāyam** alt. ca. 100'—13-20 February, 1933.
(ca. 9°35' N. × 76°31' E.)

A fairly large town and the district headquarters, surrounded by extensive cocoanut and paddy cultivation. Canals connect the town on the western side with the Vembanād Lake, a larger backwater lagoon. The water in this lake is brackish except for a couple of months during the monsoon when it is said to be potable. All around the margin of this lake are extensive cocoanut plantations and paddy cultivation. The paddy lands are below the level of the lake and the water has to be kept out by laboriously constructed dykes. A species of *Pandanus* is largely grown on these dykes or bunds its roots acting as reinforcement material and helping to hold the mud from being washed away. The paddy lands are left fallow every alternate year. The dyke is breached and the water allowed to flow in and completely submerge the land.

Ploughing in the submerged fields is done by means of buffaloes whose backs and snouts alone show as little ridges above the surface of the water while the ploughman walks behind them often immersed to his chest. Two crops are sown and gathered in quick succession between the end of the S.-W. Monsoon and its commencement next year.

The bunds or portions of them with the tall grass and *Pandanus* stand out like little islets, forming ideal haunts for *Acrocephalus stentoreus* and *Prinia inornata* and offering favourite nesting sites to *Ploceus manyar.* The backwater canals are lined with Cocoanut, *Pandanus, Thespesia populnea* and *Cerbera odollam* trees, the last with white flowers and round green fruit of the size of tennis balls.

Beyond the paddy-lands and in among the cocoanut groves are little habitations and homesteads surrounded by trees of Areca-nut, Jack-fruit, Cashew, Mango and Banana. In this facies are to be found such birds as *Leucocirca, Tchitrea, Molpastes,* Mynas, Parakeets, Lorikeets, Striated Munias and the like.

The places visited in Vembanād Lake were: Aleppey, Kūmārāgām and Munro Island (Padīramanal). The first is a sea-port and a busy trade centre. Kūmārāgām is one vast expanse of cocoanuts and paddy with huts here and there surrounded by banana and jack. It was here that the first lot of *Psitta-*

cula krameri in Travancore was met. Munro Island is a flat oval piece of land, 8-10 miles west of Kottāyam, under paddy and cocoanut. It is cut up by irrigation channels or trenches for watering the young cocoanuts, whose banks are in places covered with *Pandanus* tangles, as are also the edges of the island itself for the most part. In the paddy-fields here, snipe are plentiful.

Vembanād Lake has crystal clear water through which the sandy bottom (8-10 ft. or more) below is clearly visible. It is on the whole a disappointing place from the ornithological point of view as it presents an open expanse of water for many miles in every direction with no sandbanks or reed-covered islets. Except for some gulls and terns and one or two gigantic flocks (10,000 or more!) of teals—chiefly Garganey, and a few Whistlers—little else was noted.

On the eastern (the land) side of Kottāyam there are again extensive groves of cocoanut, which a few miles inland gradually give place to pepper cultivation. This in turn changes into rubber plantations interspersed, as at Urūmbikera, with reserved forest areas, mostly deciduous but often intermingled with evergreen species. The nullahs here are densely lined and overgrown with *Sarcocephalus missionis* trees. In the thickets much Lantana and *Acacia incia* with sprawling pliant branches and recurved thorns, occurs. The damper portions of the banks and dank hollows are thickly overgrown with a species of wild zingiberous plant with tall straight stems knotted like bamboos, the knots being much swollen. They are known in Malayalam as 'Channa'.

The rubber plantations extend all the way up to Mūndakāyam and the foot of the Peermade hills.

The temperature at Kottāyam was as follows: 6-30 a.m., 76-80° F.; highest during the day 94° F. The humidity is excessive. The annual rainfall is 124·6″ received principally during the S.-W. Monsoon.

While in the Travellers' Bungalow at Kottāyam, I had a visit from a local 'sportsman', a retired police constable, who having heard that I was collecting birds, called to book orders. The 'bag' he brought along as sample consisted of battered specimens as follows: 3 *Acridotheres tristis*, 2 *Halcyon smyrnensis*, 1 *Æthiopsar fuscus*, 1 *Oriolus kundoo*, 1 *O. xanthornus*, 2 *Thereiceryx viridis*, 1 *Chloropsis jerdoni*. The man boasted that he got, and could get, them in every month of the year—whether they were breeding or not—ostensibly for food. He said there were in that locality several other shikaris like himself who shot everything that came along provided it was large enough or in sufficient numbers to expend powder and shot on. This is a practice that the authorities must take immediate notice of and put a stop to.

6. **Peermade** alt. ca. 3,200′—20-26 February, 1933.

(ca. 9°34′ N. × 77°0′ E. About 40 miles due east of Kottāyam, in the High Range.)

Bare open hills covered with dense clumps of a tall coarse grass. The hill-tops are often rounded, but some have jagged, precipitous contours. The ravines and valleys of streams, both down the slopes as well as along the foot of the hills, are everywhere clothed in patches of evergreen forest. In these sholas lofty trees of *Cullenia excelsa* are common. *Calamus* is a feature of the undergrowth in such spots, which, throwing out their fine lash-like 'climbers' covered with recurved thorns make progress through the jungle painful and slow. In the damper places, the wild Zingiber (Malayalam: *Channa*) is abundant. The open grass hill-tops and slopes are punctuated by clumps of a dwarf *Phoenix*. Guava trees are plentiful for miles around the town, and the scrub in the drier places is composed principally of *Lantana*. In the environs of Peermade, especially to the north, are numerous tea plantations. Little patches of cardamom cultivation also occur. The Arūdāi stream (Arūdāi being the original name of Peermade) winds through the town, running through deep-cut ravines.

Rubus absent, so also *Trochalopteron*.

The temperature at 6-30 a.m. was about 70° F., the highest during the day being 78°. The average annual rainfall is about 200″.

7. **Kūmili,** alt. ca. 3,000 ft.—26 February-8 March, 1933.

(ca. 9°37′ N. × 77°10′ E. About 14 miles east of Peermade.)

The country to the south and in the environs of Periyār Lake consists largely of deciduous forest which is interlarded here and there with patches of evergreen. The former is comprised principally of Teak, *Phyllanthus emblica*, *Terminalia paniculata* (very common), *Careya arborea* and sparse bushes of a species of *Grewia* and of *Helicteres isora*. The country is undulating with many hills and ravines and much flat grassland in between. Everywhere the undergrowth in the deciduous forest consists of dense clumps of tall elephant-grass often over 7 ft. high with, at intervals, dwarf clumps of a wild *Phoenix* and straggly sprawling bushes of *Zizyphus rugosa*.

Mortality among birds must be heavy when these large tracts of grassland are burnt, as at this season (March), both in the species which roost in the grass clumps and bushes as well as in those which nest in tree-holes at moderate heights, such as *Parus* etc. and of course in all ground-birds like Bush-and Bustard-Quails. These fires must be especially destructive during night when fanned by a strong breeze, and when escape for the birds is impossible.

Gigantic *Bombax malabaricum* and *Calophyllum tomentosum* trees are common in the evergreen patches where they tower above the surrounding vegetation. The former are frequently 6 ft. or more in diameter at 10 ft. height, and practically uniform in girth up to the first branch at 50-70 ft.

The Periyār Lake has a maximum level of 2,861 ft. above mean sea-level. It is formed by the damming up of the Periyār River near its source. The dense evergreen forest that once covered the ravines and valleys has become submerged and at present only the gaunt trunks of the forest giants stand out of the water. This lake supplies irrigation to the rice-fields of the plains of Madura District beyond the eastern confines of Travancore. Owing to the perennial water supply and the cover afforded by the jungles of the catchment area, the environs of the lake are full of Bison, Elephants and other forms of wild life, and have lately been selected by the Travancore Government for a Game Sanctuary.

The lake itself is an absolute washout as far as birds are concerned. With the exception of a few *Anhinga*, *Halcyon smyrnensis* and *Haliastur indus* near the head-works, there is nothing, the water being mostly deep with steep shelving banks.

The country north of the Periyār Lake, towards Wundāmet or Vandāmettu is all open, bare grassy hills with an occasional sprinkling of light scraggy deciduous species of trees such as *Phyllanthus emblica*, *Buchanania latifolia* and *Dalbergia latifolia* with some Teak here and there. In the ravines on the hillsides or in between them, are small patches of evergreen shola, sometimes only half an acre or less in extent, with luxuriant undergrowth of the wild zingiberous plant (*Channa*) and rattan (*Calamus*). In these isolated patches were met pairs or a few each of *Pomatorhinus*, *Pellorneum*, *Rhopocichla*, *Culicicapa*, *Hypothymis*, *Iole*, *Irena* and *Ducula cuprea*.

The bottom valleys among the grass hills (at present all burnt out) are moist and often swampy, with dense growth of finer grass of a different species, tangled and spongy to the tread, and sometimes over 3 ft. high. In these patches *Schoenicola* was not uncommon though singly and scattered, also *Prinia socialis*. These marshy patches with their fresh green grass, and reeds at their margins, were the only features to relieve the monotony of the charred and dreary landscape. Average annual raifall 71·5″.

8. **Camp Derāmalāi**, ca. 3,000′—9-13 March, 1933.

(In the Panthalam Hills, ca. 10 miles due south of Kūmili across the Periyār Lake.)

The country between the southern end of the Periyār Lake, i.e., from about the dam almost to Camp Derāmalāi, consists of a vast succession of open grass-topped hills interspersed with patches of evergreen shola in the moist protected ravines. Evergreen forest commences in the neighbourhood of Derāmalāi and the forest-clad hills and ridges (Panthalam) succeed one another almost unbroken southwards down to Kōni in Central Travancore.

Enormous trees of *Canarium strictum*, *Calophyllum tomentosum*, *Cullenia excelsa* and *Vateria indica* are prominent, while the many species of lofty *Ficus* (now in fruit) attract numerous birds everywhere. The dammer trees (*C. strictum*) with their peculiar outwardly flaking bark are suggestively known in Malayālam by a name which means 'that which a lizard cannot climb'.

To the south-west of Derāmalāi the forest extends to Rāni over very hilly country which forms the catchment area of the Pambāiyār River. The tops of many of the evergreen hills in this direction present open, dome-shaped grass-covered patches with outcrops of sheet rock.

Camp Derāmalāi is on the northern fringe of the Panthalam Hills. Beyond Downton Estate (Cardamoms)—where thanks to the hospitality of the genial proprietor Mr. J. R. Vincent and his sister, we are encamped—to southward there is practically no human habitation in the forest.

Average annual rainfall ca. 71·5″.

9. **Rājampāra,** ca. 1,350′—15-21 March, 1933.

(ca. 9°22′ N. × 76°54′ E. About 20 miles W.S.W. of Derāmalāi on the western boundary of the Panthalam Hills.)

Hilly country, ridge upon ridge, mostly deciduous forest or open slopes under tall coarse grass, with patches of evergreen here and there in the ravines. In the deciduous forest, gigantic trees often over 120 ft. high and 10 ft. girth, of *Calophyllum tomentosum* are common, at present leafless and heavily laden with fruit which is largely eaten by birds such as *Thereiceryx*, *Dendrophasa*, *Ducula* and many others. Other common species in this facies are *Xylia xylocarpa*, *Dalbergia latifolia*, *Careya arborea*, *Gmelina arborea*, *Terminalia paniculata* and *Bombax malabaricum*. Among the undergrowth in deciduous country, by far the most abundant species is *Lantana camara*, with *Acacia intsia* a close second. Sprawling trees and bushes of *Zizyphus rugosa* are also common. Thickly bordering the ravines and anywhere where the hillsides retain any moisture, i.e., where there is any depth of soil (for the bed-rock is often denuded and exposed) grows in great profusion the wild zingiberous plant known as 'channa' already alluded to. Evidences of recent abundance of bamboo are noticeable here and there, especially about ravines and nullahs, in the shape of decaying root-clumps of those that died after flowering, a couple of years ago. Here and there also are common, usually singly, Cycad palms (*Cycas circinalis*) now mostly leafless with fruit, or sprouting their fern-like leaves. Also common here is a species like the Asparagus fern.

The evergreen patches contain the usual species, *Calamus* brakes being somewhat more prominent among the undergrowth.

Rubber is largely grown in this area, one estate of the Malayalam Plantations, Ltd. alone (Lahāi) having a planted acreage of 2,300. The locality at this season is subject to sudden and terrific cloudbursts of short duration, but heavy precipitation. On two successive evenings rain fell for about an hour measuring over 2″ each time.

The highest temperature recorded was 90-92° F.; the lowest 70-72° F.

The annual rainfall averages 139·4″, by far the greater part being received during the S.-W. Monsoon.

10. **Tenmalāi,** alt. ca. 500′—22-28 March, 1933.

(ca. 8°58′ N. × 76°4′ E. On the railway line near Ariānkavu Pass in Central Travancore.)

Hilly foothills country with mixed deciduous and evergreen jungle, more of the latter, the facies being similar to that at Thattākād. Teak, *Hopea parviflora* and *Bombax malabaricum* are plentiful, and there is much *Calamus* in the evergreens.

Many of the hillsides present precipitous scarps of rock, and outcrops of huge boulders occur here and there. The hills in the neighbourhood of Tenmalāi rise to about 2,000 ft. It was only at this camp that *Lyncornis* was met with, and a whistling owl (identity problematical) heard for the first time in Travancore.

The temperature ranged between 80° and 96° F. The average rainfall is about 115·2″ annually.

11. **Trivandrum,** ca. Sea-level; 29 March-6 April and 16 July-15 August, 1933.

(ca. 8°30′ N. × 76°57′ E. Capital of Travancore State.)

Low coastal terrain, more or less similar to that about the Konkan coast near Bombay. Rice cultivation and cocoanuts plentiful; also Palmyra palms (*Borassus flabelliformis*). Other familiar features of the vegetation are *Thespesia populnea* and *Calophyllum inophyllum*. Paddy crops now (April) standing in fields bordering tanks, and Weaver Birds (*Ploceus philippinus*) busy nesting.

Mr. N. G. Pillai has furnished the following information regarding the localities in Trivandrum Taluk where he collected between 15 July-15 August.

(a) *Trivandrum Beach*: 16-7-33, 21-7-33, 1-8-33, 12-8-33.

'There are two main roads diverging from the Beach and entering the town, one at the northern end, the other at the southern. On either side of these roads are planted a good many Casuarina trees. The roads traverse a long tract of sandy waste, on the extreme west of which is a long line of houses, mostly fishermen's huts, and cocoanut plantations. During the rainy season most of this sandy tract is under water, leaving small islets here and there. On these can be seen plovers, terns, paddy-birds etc. Among the Casuarinas and neighbouring palms, the Swallow-shrike, Roller, Bee-eater, Kingfisher, Magpie, Robin, etc., are frequently met with.'

(b) *Pattom*: 17-7-33, 22-7-33.

'It is about 3 miles away from the heart of the town (Trivandrum) with an elevation of ca. 100 ft. Small hillocks covered with laterite pebbles and bearing tapioca cultivation are quite common here. In between the hillocks are paddy-fields. These are in blocks separated by bunds, each block being cultivated separately. In one whole patch of paddy with different plots, some will be nearing harvest, some just ploughed, while yet others will bear half-grown plants.'

(c) *Pūlayanārkotta*: 18-7-33, 6-8-33, 11-8-33.

'This is a small hill, ca. 200 ft., overlooking the Veli Lake, about 5 miles from Trivandrum. The soil is mainly laterite, in some places chalky and covered with pebbles. The hill is a Casuarina reserve. There is a dense undergrowth of *Ixora*, *Acacia* and other thorny plants. The common birds of this place are *Otocompsa, Molpastes, Glaucidium, Dendrocitta, Acridotheres, Leiopicus, Micropternus, Oriolus, Dendrophasa,* etc.'

(d) *Thirūmalāi*: 20-7-33, 24-7-33, 25-7-33, 30-7-33, 6-8-33.

'This is another small hill about 5 miles east of Trivandrum, the highest point of which is about 200 ft. It is studded with granite boulders of various sizes and shapes. The south-eastern side of the hill is covered with lemon grass (*Andropogon*). Towards evening on 30 July, I saw at this place about a hundred bulbuls (*Otocompsa*) flying about here and there before retiring to roost.'

(e) *Kuttani*: 26-7-33, 29-7-33, 10-8-33.

'This is a piece of hummocky country with small hills varying from 100-200 ft. Most of these bear tapioca, plantain and cocoanut trees, etc. leaving patches of evergreen forest here and there. One such is the Serpent Grove alluded to in Ferguson's paper, about half an acre in extent, adjoining a paddy-field. Huge trees like *Ficus,* and Talipot palms (*Caryota urens*) are seen here. The dense undergrowth of canes, screwpine and a host of climbers makes the places well-nigh impenetrable. It was here that I came across *Rhopocichla*. From a similar patch about a mile from here I got *Melittophagus*.'

(f) *Mārūthānkūzhi*: 27-7-33, 28-7-33, 31-7-33, 2-8-33, 15-8-33.

'About 3 miles east of Trivandrum. There is a small river—the Killiār—flowing past this place. A dam is constructed across this river and the Kochār takes water from this river to a big tank in the Fort. The Kochār flows past the foot of a hill covered with cultivation.

(g) *Veli*: 30-7-33, 13-8-33.

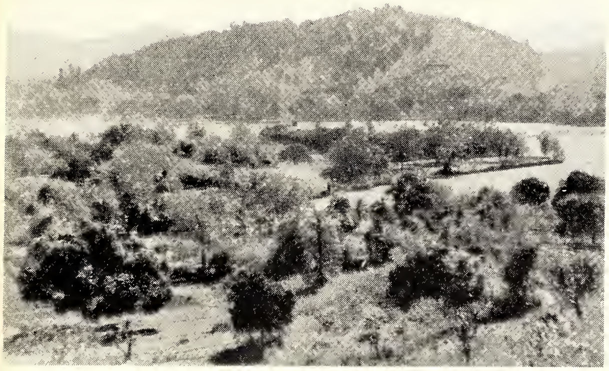
'There is a small lagoon here which communicates with the sea during the Monsoon. It is principally sandy country with stunted Cashewnut, *Calophyllum inophyllum* and other trees. Cocoanut and Palmyra palms are also very abundant. About a mile east of this place and on one side of the lagoon is a small grass-covered hill about 100 ft. high, studded with granite boulders.'

(h) *Akkūlam*: 31-7-33.

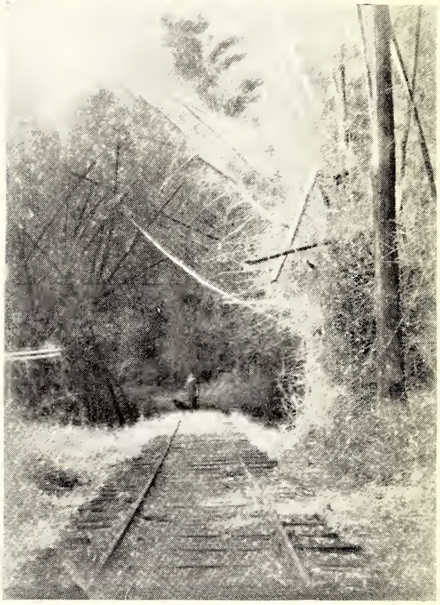
'This is a bit of hilly tract about 3 miles north-west of the town. Hillocks covered with stunted *Ixora* are a feature of the place. Lower down the slopes we get tapioca cultivation followed by trees like Tamarind, *Artocarpus* and *Ficus,* and still lower down, by paddy fields. The ground is covered with pebbles of laterite. Larks and Pipits are very common here. Towards the end of April I had come across a number of Yellow-wattled Lapwings here, all of which have now disappeared.'

(i) *Golf Links*: 2-8-33, 7-8-33, 14-8-33.

'This is a slightly elevated plateau (about 150 ft.) about 3 miles from

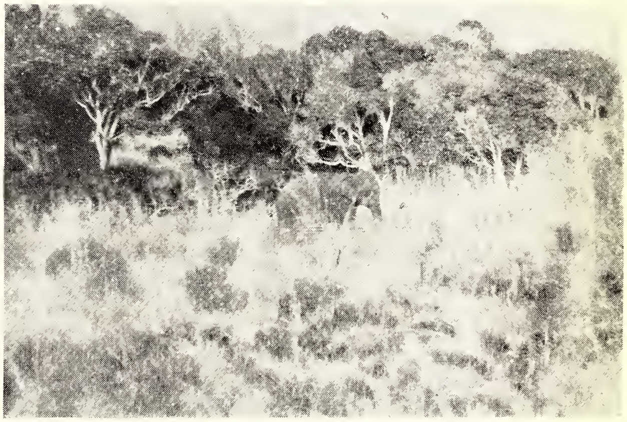


Typical country at Wadakkāncheri showing paddy cultivation in flat " valleys."



Bamboo Forest, Kuriārkūtti, with Cochin Forest Tramline.

A Backwater Canal, Kottāyam.



Tall grass (*Andropogon*) country on verge of *shola*, Santhanpāra, with an unlooked-for thrill in the middle distance !

Photos *Author*

Typical country about Cape Comorin with the Ashāmbu Hills in the background.

Photos *Author*

Looking across the "Gap" at Aramboli.

Trivandrum. It is an extensive green where Yellow-wattled Lapwings, Larks and Pipits are found in large numbers. There are trees like Mango, Tamarind, etc. planted all round the border and here the commoner birds Orioles, Wood-shrikes, Chloropsis, Magpie Robins, etc. are met with.

(j) *Kovālam*: 3-8-33.

'About 8 miles south-west of Trivandrum, near the sea. The coast is formed of rocky cliffs forming a sort of belt between the low lying paddy-fields on one side and the sea on the other. Small hillocks covered with boulders may be seen slightly removed from the shore. The ground is covered with vegetation. I did not come across any sea birds here.'

(k) *Cattle Farm*: 4-8-33.

'Slightly wooded country about 8 miles north-east of the town. Similar in features to Pattom, Akkulam, etc.'

(l) *Nettayam*: 5-8-33, 9-8-33.

'About 8 miles east of the town. Hilly country about 200 ft. alt., covered with cultivation. Farther to the east, about 12 miles from this place, the Karamanai River meets this chain of hills.'

(m) *Poojāppūra*: 5-8-33.

'ca. 120 ft. Country similar to Pattom. The Karamanai River flows past here. Slightly removed from the river is a large sheet of water, about 10 acres in extent. The Skua, included in my collection, was captured from this place.'

(n) *Mūkkūnnimalāi*: 8-8-33.

'This is the highest hill in Trivandrum (ca. 800 ft.). About 5 miles S.-E. of the town. It is an evergreen forest and the sides of the hill are covered with a thick undergrowth of shrubs and thorny creepers. Granite boulders of varying sizes and shapes cover the hillsides. I came across the Ruby-throated Bulbul here.'

The average annual rainfall at Trivandrum is 66·9″.

12. **Cape Comorin,** ca. Sea-level; 6-14 April, 1933.

(ca. 8°5′ N. × 77°34′ E. The extreme southern point of the Indian Peninsula.)

Plains country similar to that about Trivandrum, with paddy cultivation here and there. *Thespesia populnea*, *Calophyllum inophyllum*, Cashew (*Anacardium occidentale*) and the umbrella-shaped *Acacia planifrons* are amongst the most prominent trees. *Borassus* and Cocoanut palms are abundant. 'Milk-bush' and *Inga dulcis* are largely used for hedges, and Cactus of a peculiar species, *E. antiquorum* (?), is plentiful.

Tamarind and *Pithecolobium saman*, an introduced species, are both very common and the latter grows to large size. *Melia azadirachta* also occurs freely.

The soil is chiefly moorum. A few miles north of the Cape commence the Ashāmbū Hills, steep, ragged precipitous and pinnacled peaks and ridges, mostly bare and rocky, with stunted vegetation, greener and more luxuriant in the ravines.

The temperature and humidity are about the same as at Trivandrum though the rainfall is considerably less, the average being about 40″ per annum.

13. **Arūmboli,** alt. ca. 250′—15-22 April, 1933.

(ca. 8°15′ N. × 77°15′ E. In a gap or pass through the Ashāmbu Range, through which runs the highway from Nāgercoil in South Travancore to Tinnevelly in Madras Presidency.)

The gap at its narrowest is about 2 miles wide. The hills on the northern and southern side of it are rocky, jagged and often precipitous with ragged pinnacles and deep clefts. The lower slopes are covered with sparse stunted vegetation of which the principal species are: *Dodonoea viscosa*, *Euphorbia neriifolia* and *E. antiquorum*, *Opuntia Dillenii* and very sprawling and spreading bushes (usually up to about 2 ft. high) of a small leaved thorny *Randia* (?) and of *Acacia intsia*. At the foot of the hills and in the 'Gap' there is cultivation bordered by scrub jungle consisting of *Melia*, Babool, etc. with Borassus palms sprinkled freely, especially along the bunds separating the fields. *Acacia planifrons* lends tone to the botanical features. Dense bushes of *Lonicera* sp. occur among the scrub of which *Phyllanthus reticulatus* and *Salvadora persica* (now in fruit and attracting many birds) are also common components. The rainfall averages 35.3″ per annum.

14. **Balamore Estate,** alt. ca. 2,000′—23-28 April, 1933.
(ca. 8°27′ N. × 77°23′ E. In the Ashāmbū Hills.)

Evergreen forest interspersed with coarse grassland on many of the hilltops and slopes. On these are scattered moderate-sized trees of *Careya arborea, Calophyllum Wightianum* and sprawling sparse bushes of *Zizyphus rugosa.* The surrounding hills, which rise to 6,000 ft. are more precipitous and rocky with jagged peaks and contours than in North Travancore. In the evergreens there is a dense and luxuriant undergrowth of rattan (*Calamus.*) The hills all over this locality bear traces of abandoned tea and coffee estates, the soil having proved too poor for them. The areas once cleared for these, are now overgrown with coarse grass or more commonly with Lantana scrub, the thickness of which must be seen to be believed. About 4 miles to the north as the crow flies, and at an elevation of about 4,000 ft., is Mūthūkūzhi Palace, formerly used by the Maharajas as a hot weather resort. After about 3,000 ft., bracken begins to increase. It is extremely abundant higher up where also appears (between 3,500 and 4,000 ft.) *Rubus ellipticus.* Patches at this elevation are densely under Eeta (*Ochlandra travancorica*) and the facies dominated by these three species seems to be the most suitable for *Trochalopteron,* which came into evidence as soon as about 4,000 ft. was reached.

About 4 miles west of Balamore is the Kodāyār Lake, formed like the Periyār, by damming up the Kodāyār River, and used for irrigation purposes. At the elevation of the Travellers' Bungalow, 2,000 ft. (situated on the edge of the Tea Estate), Mango and Jack trees appear to thrive.

Rainfall average: 81·5″ per annum.

COCHIN STATE.

15. **Kūriārkūtti,** alt. ca. 1,600′—12-22 November, 1933.
(ca. 10°25′ N. × 76°43′ E. In Kodasseri State Forest.)

Forest mixed deciduous and evergreen, more of the latter on the higher surrounding hills, especially in ravines etc. On the hillsides, where steep and precipitous, tall coarse grass grows on a denuded rocky soil with outcrops of sheet rock. In such places *Cochlospermum gossypium* grows. The forest round Kūriārkūtti is now full of *Bambusa arundinacea.* Forty years ago there was no bamboo available in this part, so that the Forest Working Plans Officer reporting on the area mentioned that owing to want of bamboos for rafts, the logs could not be floated down the Parambikolam River and recommended the building of the existing Forest Tramway. The timber extraction has been carried on in a very destructive manner and in place of the denuded forest, bamboo has made its appearance in great density and profusion. Some of the commoner trees in the forest are *Calophyllum* ('Poon'), *Hopea parviflora, Xylia xylocarpa, Lagerstroemia parviflora* ('Venteak'). They grow to magnificent size and quality. Here and there are also sprinkled enormous trees of *Bombax malabaricum.*

Creepers of *Butea superba* are common in the deciduous-and-bamboo-forest, festooning the trees and twining up their stems.

Helicteres isora is a common component of the undergrowth. It is now in flower and invariably attracts Chloropsis and Sunbirds.

The bottom valleys among the hillocks in the bamboo forest are often open swampy spaces of varying size, covered with rank grass and other vegetation and much frequented by Elephants, Gaur and other game.

Men and boys of the aboriginal Kādar tribe scour the country all day long with bows and pellets killing everything they can. I saw *Pycnonotus gularis* and *Ægithina tiphia* killed in this way. They also wage unceasing war upon the nests of the Great Hornbill whose young are esteemed a great delicacy.

The average rainfall is 125-130″ annually.

16. **Wadakkāncheri,** alt. ca. 400′—23 November-2 December, 1933.
(ca. 10°40′ N. × 76°15′ E.)

Hummocky country, soil mostly laterite. The little hillocks are usually denuded of soil and littered with loose stones. They are covered with deciduous forest but in the damp ravines evergreen species occur. *Xylia* and *Calophyllum* saplings are common while the undergrowth is mainly of *Helicteres isora.* Lower down bordering the flats or bottom valleys (which are fertile owing to soil washed down from the hillsides, and in which paddy is extensively grown —2 crops a year) are dense thickets of Lantana.

Teak and *Dalbergia* are fairly plentiful in patches among the deciduous secondary jungle on the hillocks. On the sides of the hummocks, wherever the soil permits, are terraced fields of Gram and tapioca (*Manioc*).

Phyllanthus reticulatus grows commonly among the hedges, and its berries are largely eaten by Bulbuls, Orioles and other birds. Around the homesteads Cashew, Jack and Cocoanuts and Plantains are grown.

The localised bird associations or mixed hunting parties commonly met in this locality, at the edge of forest clearings, consisted chiefly of: *Dendrocitta vagabunda, Parus major, Graucalus macei, Tephrodornis sylvicola, Pericrocotus flammeus, Chaptia aenea* (very common), *Dissemurus paradiseus* and *Oriolus kundoo.* They invariably had *Turdoides* or some other ground rummaging species, and woodpeckers for their nucleus.

Loranthus longiflorus largely parasitizes *Dalbergia* and Cashew trees in this locality. It was now in flower and attended by the usual visitors, Sunbirds and Flowerpeckers.

17. **Nemmāra,** alt. ca. 300′—3-11 December, 1933.
(ca. 10°35′ N. × 76°37′ E. On the southern edge of the Pālghāt Gap.)

The Nelliampathy Hills commence here. Among the low rocky hillocks or foothills as they may be called, Nim, Tamarind and *Terminalia paniculata* seedlings are common. Lantana and sparse scraggy grass grows everywhere from accumulations of the soil in fissures and hollows among the rocks. The lower hills are covered with Teak, *Boswellia serrata, Xylia, Dalbergia* and other deciduous species, the undergrowth being composed for the most part of *Helicteres isora* and *Acacia intsia.* The teak trees in this locality are heavily parasitized by *Loranthus longiflorus,* the Flowerpecker *Dicaeum erythrorhynchos* being noted as the chief, if not sole, mischief maker.

Sparse grass-covered or bare hillocks of sheet-rock are commonly interspersed among the wooded ones. In the valleys or flats among the hills, paddy grows luxuriantly and there are also many natural tanks formed in the hollows which supply the irrigation to the paddy-fields.

18. **Pādagiri,** alt. ca. 3,000′—11-22 December, 1933.
(ca. 10°30′ N. × 76°41′ E. Nelliampathy Hills.)

This place is close to the Lily Downs mentioned by A. P. Kinloch in his 'Notes on the Avifauna of the Nelliampathy Hills' where also will be found some details of the topography. At 4,000 ft. and above, the hills have mostly bare tops with sheet-rock and straggly grass, which grows wherever sufficient soil has accumulated in the fissures and hollows to afford roothold. There are also steep scarps and precipices which form favourite haunts of the Nilgiri Tahr. On some of the gentler slopes there is the same tall coarse grass (*Andropogon*) as in the High Range of Travancore, similarly dotted with clumps of the dwarf *Phoenix.* Here and there in the ravines are evergreen sholas. The country and vegetation are on the whole very reminiscent of Santhanpāra in the Cardamom Hills of Travancore.

The Pālghāt Gap which is overlooked from the neighbouring hills is a stretch of flat country about 18 miles broad, dotted over with little hummocks or mounds of outcrop rock, but mostly under paddy with patches of light deciduous jungle and groves of *Borassus* palms.

At Tattamangalam (Chittūr) on the Pālghāt Gap, the average annual rainfall is 66″ while on the Nelliampathies over 150″ are usually registered. The mean annual rainfall at Ernakūlam is 102″; at Trichūr 132″.

19. **Karūpadanna,** alt. ca. Sea-level—25-31 December, 1933.
(ca. 10°16′ N. × 76°12′ E. On the backwaters.)
Typical vegetation and other features the same as at Kottāyam.

(To be continued).

A HUNTING TRIP IN THE SUNDERBUNDS IN 1892.

BY

VICOMTE EDMOND DE PONCINS.

(*With four plates*).

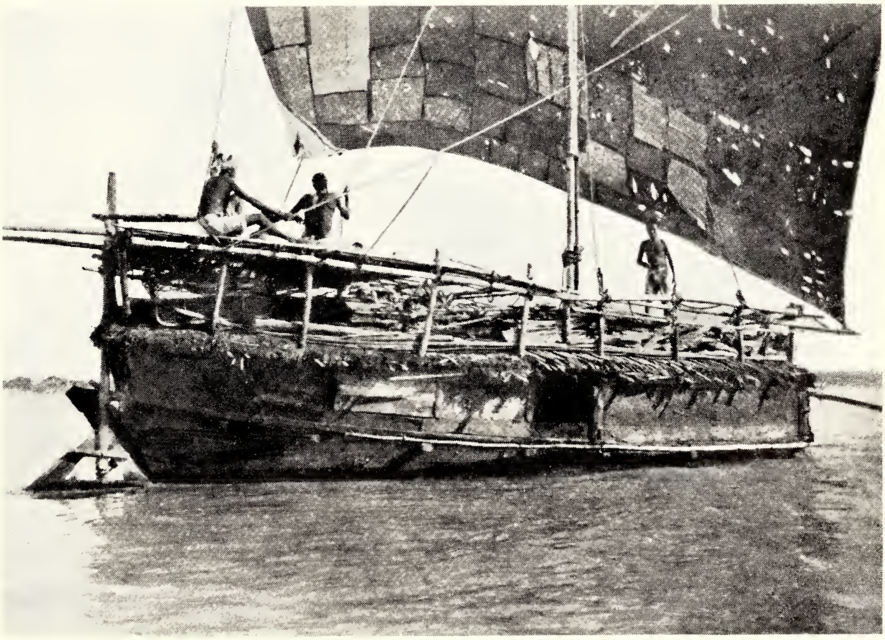
On January 2nd, 1892, I left Calcutta for a trip in the Sunderbunds. The area was not very well known at that time, the only available map was the one by James Ellison (4 miles to 1 inch), published in 1783 and revised in 1891. On this map the maze of rivers of the delta was roughly indicated, but there were many blanks. Islands were shown by numbers, and rivers between them were often nameless. Some of them changed names on their way down to the Bay of Bengal. I shall refer to that map because I have no other and, if the reader wants fuller information, it will be easy to refer to more modern maps.

My plan was to try and see something of the more or less legendary rhinoceros which were supposed to dwell somewhere in this region and, at the same time, to get as much sport as I could with any available game. Tigers were said to be very numerous, deer and pigs swarming; so little known was that part of the world, that the unexpected might happen. It was then so out of the beaten track.

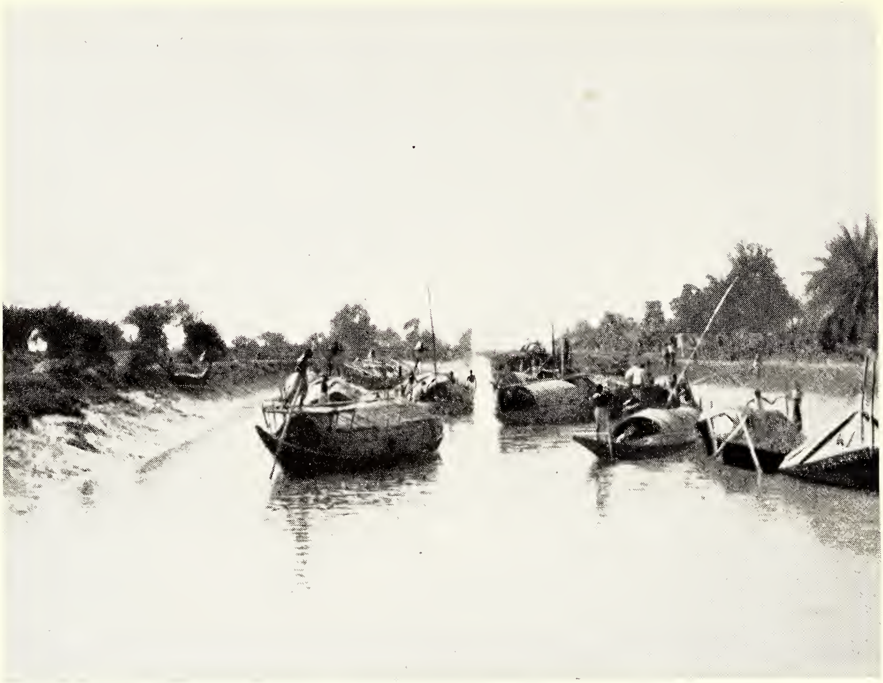
I hired from Kelso and Stewart, at Calcutta, a sort of houseboat with two small cabins as bed and dining rooms, and with it a crew of five Bengalis, another smaller boat with three men, as kitchen boat, and later on, added a small dinghy for shooting. Two so-called shikaris came with the last boat. I took my private servant and one or two of the 'nondescript' sort. They served as guides at places which they happened or pretended to know and were useful sometimes when sending for supplies or information, but otherwise often perfect nuisances. As I intended to stay a fairly long time I had to ship about two hundred and fifty gallons of sweet water. It was a difficult job as only earthern jars were available. Some broke when just filled up, others during the trip when I happened to be out. I always thought that the men, sick of the Sunderbunds after a time, did it on purpose to shorten our stay there for want of water. I had to send a boat, several times, to get fresh supplies as the life, if difficult, was intensely interesting.

The reputation of the Sunderbunds as a health resort stands very low indeed, and I should not dare to deny it. Nevertheless there were fifteen of us there for about a month and a half, and nobody ever got fever. The thermometer stood the whole time between seventy and ninety-five; the dampness was very trying. Inside my cabin, every morning, water dripped along the rifle barrels. I had to clean them every day. Frequently, there was a dense fog in the morning, the thermometer stood at eighty; while the dripping dew in the forest made a noise like heavy rain. During the rest of the day a dead stillness prevailed. More than once, when paddling up or down the rivers in a narrow dinghy, exposed to

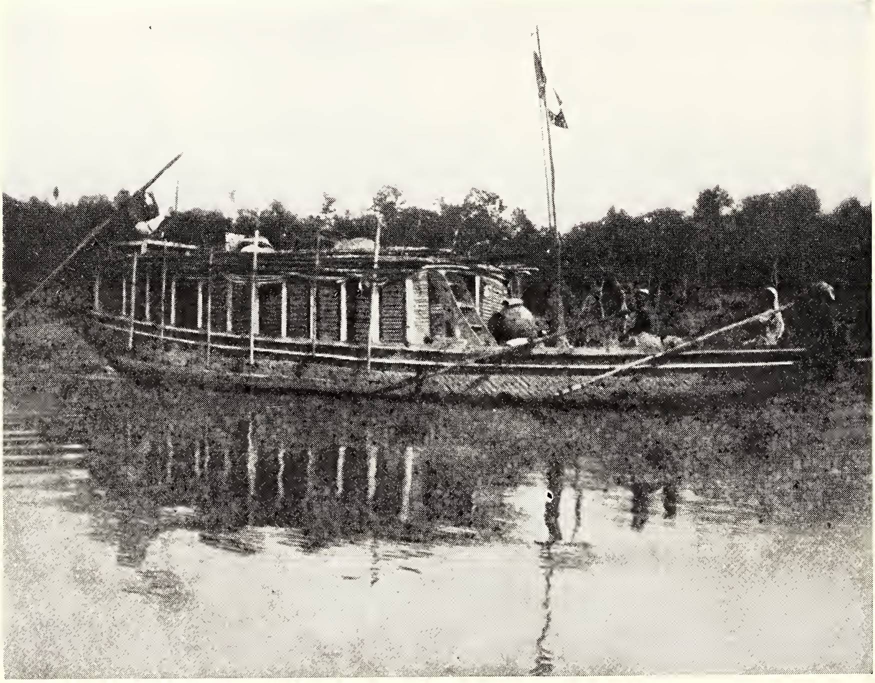
Sunderbunds, 1892. My boat under sail.



Sunderbunds, 1892. A native boat under sail carrying firewood
to Calcutta—note the water line.



Sunderbunds, 1892. Near Issuripore—Native Boats.



Sunderbunds, 1892. My house-boat.

the full glare of the sun in a blinding haze of pervading damp, I thought that the limit of discomfort had been reached. But when one had to wait between two walls of glittering mud, with just enough water to float the boat, until the tide returned to resume the journey, I concluded that that paddling in the open was better.

The northern fringe of the Sunderbunds is more less inhabited and cultivated, but where the forest has the upper hand it is mud, trees and water. During my whole stay I never saw a clear space ten yards across. It was a dense forest of stunted trees with heavy foliage, or of enormous trees overgrown with creepers and thorny canes and of palms with immense leaves shooting straight out of the mud along the banks of small rivers. Everywhere roots sprung up forming a barrier which made walking very trying. Near the sea, the trees stood like gigantic spiders on roots four feet clear out of the mud. At spring tides, the whole of the forest was, for a while, inundated. I dare say there is not a square foot of dry soil in the great majority of the Sunderbunds. Landing meant sinking up to the knees in a sloping bank of sticky mud, the like of which I saw only at the mouth of the Guadalquivir. Once on the level under the forest, one had to plod along in deep mud. There was no grass, no undergrowth, some parts were covered by very dense tangle of thorny bushes, other parts were clearer under a canopy of foliage impervious to the sun, but so close were the trunks that the view was limited to not many yards.

The best and shortest way to reach the distant parts of the forest was by making use of the many small rivulets, when broad enough to take the dinghy. They were generally six feet broad and several feet deep, flowing between sheerly cut banks covered by big trees or lined by big screw palms. With the tide coming in, it was possible to proceed with it at a fairly rapid rate. The rising water raised the boat and brought one's head level with the top of the banks. Thus it was often possible to get a view under the vegetation for some distance. It was marvellous to inspect silently these deep forests without movement, noise, or exertion, the only thing to do being to keep the boat straight on. Sometimes it was necessary to land and pull the boat over a bump of mud or round a too sharp curve. As the boat completely blocked the bed of the little channel, the water collected rapidly behind it so that it was quickly raised and shot forward at great pace. I used to sit in the middle of the boat as low as possible, with one paddler astride the prow and another astern, their feet just tipping the water. If anything interesting came in sight it was possible to get a shot at close range or land for tracking. When the tide turned it was necessary to come down with it so as not to be left stranded far away in the forest. The great drawback was that our movements were controlled by the tides, which made it impossible to reserve the more comfortable hours of the day for the work in hand.

The whole of the Sunderbunds is teeming with life of every sort. I still regret not having been more learned in every branch of Natural History to make the best of my trip there. Forty-two years ago knowledge of the subject was yet, to a certain extent, in its infancy. What had been printed was scarce and difficult to get. We were explorers.

I joined my boats, sent ahead from Calcutta, at Mutlah and Canning, and began travelling with the tide. I went east to Bampurah, then to Sahabkhali and the Jaboona River. There were some cultivated rice fields on the way. A few natives of rather wretched physique took a great interest in my boats and kept following them on the bank. They were handling quantities of a fairly large fish with a very hard skin and an enormous flat head. They used to rub them sharply on the boards of their boats so as to soften the skins before eating them. A tiger had followed a path along the river. Numerous tracks of others were to be seen everywhere. Muggers were fairly numerous, and birds of prey of many sorts conspicuous all over. One of them, a large brown buzzard with a white head and chest is common all over the Sunderbunds.

Near Patang, the Jaboona may be about four hundred yards broad. By a small branch of the river I got a short cut to Bungsipore. The crossing was made during a dark night, with branches of overhanging trees brushing the decks every now and then. Jackals were howling at us along the banks and the men insisted on my keeping on deck with a rifle, afraid of a possible tiger coming to pick up one of them. I don't yet believe that there was really any risk of that sort.

Bungsipore was teeming with birds of prey, waders, and several species of heron. Here, I enlisted two so-called shikaris who pretended to know the Sunderbunds, and went with them for a stroll ashore.

I found rice fields all along the limits of the forest. To protect them against game, very long and coarse nets, made of bark, were fixed on posts over six feet high and machans for watchers were to be seen at frequent intervals. Footprints of wild boar and spotted deer were exceedingly numerous, and pugs of two different tigers were on the path, a sort of narrow embankment along the rice fields.

The soil was wet and muddy, the jungle very dense and the view was so restricted that I could not see anything. But I was introduced to a novel form of shooting. The men made me climb one of the big trees after them. Once fairly seated amongst the branches, twenty feet at least over the ground, they set up a growling, howling and shaking of the branches, in fact doing exactly what I should specially object to if wanting game. The reason for their behaviour is this:

A brown short-tailed monkey, going in packs of sometimes fifty is common in the majority of the Sunderbunds. The deer are quite used to them and to their antics and seek their company. When these pugnacious brutes dispute or fight amongst themselves, they break small branches in the trees and the deer then get the leaves which fall to the ground. This is their staple food as no grass grows in the forest. It is an interesting example of commensalism. That is why an imitation of the noise made by monkeys attracts the deer. I tried it many a time after and shot a few deer coming under my tree.

Some marvellous birds passed quite close to me. One, a glossy black racket-tailed drongo shone in the sun like silver. The broad terminal tufts of its wire like tail feathers appeared like two butterflies following its flight. Another black fellow, probably a species of king crow, had a fine forked tail. A little later, a dark brown squirrel with a sharp pointed head, a very long tail with rather short hairs, came to eat some leaves at a few feet distance only. He was darker and a little bigger than our common squirrel. This I gather may have been some species of tree shrew and there were always troops of short tailed macaques in evidence.

On the main river, from four to six hundred yards wide, many muggers were basking in the sun on the sloping mud bank. Some appeared to be enormous—the great majority about ten feet long. When coming out of the water they generally go up the bank and then turn round so as to have the head looking down on the water. As the mud slopes at a fairly steep angle they have only to glide down to get into water again. They do it extremely quick. I lost many wounded or dead ones tobogganing in that way. As the rivers are very often fifteen to twenty feet deep, and the muddy slope goes right down, any mugger moving is lost. I never saw one floating at any time, though I shot many when coming back to my boats in the evening. I measured a large one, shot dead in a patch of flat mud and found it to be 21 ft. 5 in. I lost another looking a little bigger. I dare say they have been shot a few feet longer. They are all of the broad mouthed variety, supposed to be possible man-eaters. Without saying decidedly that they are not, I don't believe it; because not only did I never see one take a man, but I can almost say the reverse.

During all my stay in the Sunderbunds, I had muggers in sight almost continually. I shot a good many heads of various game and, after cutting what I required, used to push the remains overboard, in the water. When anchored in the same place for several days, each tide brought back the bodies thrown overboard, so that they passed to and fro, twice a day. No mugger touched them, and there were hundreds all about. All the same I should not like to trust one, and never refused them a cartridge when it did not interfere with my sport. I remember vividly two experiences in which muggers played a dominant part. Once at sunset, paddling back after a long hard day in difficult jungle, I was drifting slowly with the tide in the small dinghy, surveying the bank of a large river. At any turn I expected to come on a rhino I had been tracking the whole day and which I knew to be not far away. The dinghy was, at most, eighteen feet long and three feet broad, I sat low down in the middle to balance it properly. The two men, fore and aft, sat astride on the narrow ends of the boat, their feet just tipping the water. Every now and then they slowly and silently touched the water with their paddles so as to guide the boat. Left hand on the gunwale, with the barrel of my rifle resting on it, I intently took stock of everything coming in sight. Suddenly I had the impression that the colour of the water under my left hand, along the boat, was undergoing a change. At a certain depth the muddy water was getting greyish, then slowly, the dim, almost foggy, patch took the form of a large mugger coming more clearly into view as he rose alongside the dinghy. Just under my left hand I could see his outstretched toes, then his grey wicked eyes broke the surface of the water without hardly a ripple. He floated alongside for a short distance, then sank slowly down without a move and faded away in the muddy depths. A small bubble rose to the surface and stood there for a while and it was all over. It was so unexpected, so ghost-like that I could hardly believe it. I think he came to see what we were. The slightest move from any of us might have spelt disaster. The forward man had his feet not more than three feet from the tip of the mugger nose, he never saw anything, and just turned round to inquire what it was when he heard the man astern muttering something.

Sometime after this, I was trying for tiger about fifteen miles south of Issuripore. The jungle there was extremely dense. After being reclaimed for cultivation at a distant time, it had been given up as hopeless. In deep forest, a sort of embankment, about three feet high over the surrounding ground, afforded a narrow path. It ran some 2,600 paces, at right angles with the river and then took a right-hand turn for another 1,500 paces. Tigers used this open, narrow and dry *bund* during their wanderings. I tied a goat as a bait, and sat up for them at night. One night, at about eleven, with a glorious moon, having seen nothing, I started back for my boats. The tide would not allow me to return much later. The path I had to follow was the only one, and a regular one for tigers. Fully expecting to meet a tiger there I walked first, rifle in hand, my two men following with two spare rifles. Shortly after turning the corner, some 2,600 paces from the river, I heard a move ahead in the heavy jungle on the right of the path, about ten yards away. I stopped sharp, rifle at the shoulder, fully expecting a charge from a tiger. A short silence, then a slow movement in the low branches, as if an animal was making a cautious advance in my direction before an open charge. Then came a rush straight at me and out of the low branches emerged the ugly head of a mugger which I shot dead. He was an ordinary mugger not particularly big. The distance to the nearest water, over deep muddy soil and heavy jungle, was at least 2,500 paces. He may have meant business, but what interested me was to have proof that these brutes do travel long distances out of the water, at least at night in the Sunderbunds.

Spotted deer were common all over, right down to the sea. I several times heard them braying or calling, without any apparent cause, in the middle of the day. One of them even answered our poor imitation of its call and came a certain distance our way. They don't seem to grow particularly good heads there. Hog deer were also to be found, at least half way down to the sea. Both these deer feed exclusively on leaves as there is no herbaceous vegetation in the Sunderbunds. The low branches are devoid of leaves to a certain height as if pruned and I even saw one stag standing on his hind legs to reach some branches just as Waller's gazelle does for the same purpose. Round broken leafy branches their tracks are many. They drink the brackish water of the rivers.

Wild boar with good tusks are common. I found them mostly when going with the dinghy through forest. They appear to eat the roots of the screw palms along the water edge and certainly rely a good deal on crabs, which are about in enormous quantities. There is also a sort of tree with a large round fruit which splits in four and is full of closely pressed seeds. I found these trees in one or two places when tracking rhinos and they are common near the seashore. They grow small, thick, darkish-green almost round leaves. Boar tracks were profuse round them in the north, where my men were very much interested in them and told me they had never seen them. By the sea they were many.

Otters may be the commonest animal in the Sunderbunds, I never missed seeing their tracks anywhere from north to south. They travel overland and may be seen anywhere at any time. They are not much above ten to twelve pounds in weight and generally travel in twos or threes. I even once saw eight in a row following each other. They are great crab hunters and break the heavy shells without effort.

On certain mud slopes exposed, at low tide, to the full sun one may see scores of a little brown fish, about the size of gudgeon, resting on its two enlarged pectoral fins, near vertical holes which they dig in the mud. At the first sign of danger, with a jerk of the tail, they dive into their holes and disappear. But not for a long time. Soon one head will show here and another there. A gentle tapping on the mud with a stick will induce some of them to come out to inquire. At high tide all their holes are under water and must be blotted out. But they burrow again as soon as the water recedes.

A brute which gave me a lot of work for nothing is the Monitor Lizard. Once, when going up a tree to call stags I heard a commotion in the leaves overhead, then a bump on the mud twenty feet lower, then a great splash in the water and a dive? What could it be? '*Gua*', said my men. But what on earth was a *Gua*? What is it made like? After long and complicated explanations I laboriously made out that the *Gua* was a large animal, climbing trees like a monkey, diving like a mugger, with the long claws of a bear, head of a python and the body as large as a child's. With that description I wondered whether there was not in the deep jungles of the Sunderbunds, an unknown animal within reach of me. If I could only get a glimpse of the brute? The tracks showed long-clawed toes and something dragging on the mud between them. Then I set to work until finally I found a large lizard which I shot. There was the *Gua*—a species of Monitor, 66 in. long. The description was not very far from the mark after all. After that I saw many others. Once at the mouth of the Malancha, near the sea, five of them, one after the other, dropped from a tree almost on the top of me, in their fright and rushed to the water.

Snakes, in spite of periodic flooding at high tide of many islands, are not rare. When passing under the jungle, in the dinghy, carried on a very swift tide current, a yellow cobra swam hurriedly across, just in front of the boat, and went up the sloping left bank. The impetus made us shoot past before the snake was yet quite up the slope. The fore end paddler lifting his feet fell back into the dinghy, I, sitting in the muddle, had to lean as much as possible to the right. The snake was not two feet distant when we passed and the rivulet was so narrow that I was afraid the gunwale might catch its tail and roll it against bank, bringing it back into the boat in the worst of temper. In fact, the margin was only a question of inches. Another day a large python happened to be coiled just on the very brink of a little river when we passed it with our heads level with it. The snake did not appear to notice us. There was only a slow heaving move of the coils. As we were then on a rhino's tracks, and trying to head him, I did not get the snake. Its thickness pointed to a big one, but I never saw the head.

Insects of any sort, even mosquitoes, are certainly not abundant as, in my notes, there is no mention of them. Probably the brackish water does not agree with the larvae. I don't remember even seeing a butterfly. Once, on a tree, I was stung by a long, slender, black ant which could sting like a wasp. The sting, with a minute drop of venom, could easily be seen when the ant tried to drive it into one's skin. It could not penetrate except in the very soft parts of the hand. The pain was trifling and did not last more than a few minutes. This ant, at the slightest vibration of the tree, went hurriedly to cover on the underpart of the branches where it lay flat and motionless for a while. Probably it was its way of escaping certain woodpeckers which I never managed to see but which I heard several times at work on the trees.

The wealth of the Sunderbunds lies in its birds. In deep jungles they may be scarce. Excepting the black drongo with the long tail, the one with the forked tail, and another black species, few birds are to be met with. But, along the river, there is a marvellous display of the most gorgeous plumage. Kingfishers swarm all over, birds of prey and wading birds of different species are common. I tried, in the Calcutta Museum, to find out something about them and made out that *Dissemurus paradiseus* and *Bhringa remifer* were the scientific names of two of the above Drongos. A spotted eagle was *Spilornis melanotis*, a fishing eagle *Haliaëtus leucogaster*, a grey hornbill, *Meniceros bicornis*. But I could not go any farther, in 1892! This is a short list from my diary.

I saw no ducks or geese whatever, no divers; some of the waders were the same as we see at home. The red-legged sand-piper seems to me, with the grey heron, the most ubiquitous bird in the world—(A year later I was confronted with two of them at the small lake in the Kilik Pass, at an altitude of roughly 18,000 ft.). Several other shore birds had a very familiar aspect, but they are so difficult to distinguish from each other that I will not say anything more about them. In January, swallows were in small flocks by the sea going north, curlews, whimbrels were many at the mouth of the Malancha, and our fishing eagle, *Pandion haliaëtus*, was common. But what of the rest? Herons of several sorts were by the sea or along the swamps of the north fringe, night herons, white herons and red, snake birds perched on the dead branches all along the Eshamuttee and other rivers. Crows and black or grey vultures were in evidence on the north side, nightjars appeared in numbers every night specially on the Kudum Tullee and Pizzon Khalee Rivers, I even saw a large owl, a sort of Eagle owl. I jotted down the following list which I copy from my diary.

Large white eagle, span of six feet, slate colour over back and wings; beak slate grey without any special colour at the base on the lore, fairly long tail with a white cross bar at the end (Arabi Bankee River).

Malancha River. Large heron, red brown under, iron grey on the back.

Malancha River. Fishing eagle, grey head, body brown, legs, lower parts of the body, under parts of the tail, pure white; a brown bar at the end of the tail.

Fishing eagle black and white, with bright red legs (Eshamuttee River).

Large black storks, under parts of the body white, neck yellowish and naked, light crest of feathers at back of head.

Large brown eagle.

Brown eagle spotted white; yellow bill fading to blue in certain parts, longish stiff feathers at the back of head.

Black and white eagle with stiff feathers as a crest, at the back of the head.

Of the kingfishers I specially made notes of the following ones. A big one, about the size of a dove, with a long coral red bill, head and underparts yellow, back and wings brown, light bright blue above the tail. Another smaller one black, white and blue.

Then a white one, spotted black. (I saw one of his species in the Suez Canal hovering along the ship two years later.)

Another, very much like our home kingfisher in size and colour, but certainly brighter all over.

And yet another almost exactly similar in shape and colour, but so minute that I believe it is hardly as big as our blue tit.

Jungle fowl were common, specially in islands 170, 173, 174, 179, and down to the sea. I think they were *Gallus ferrugineus*, smaller in size than our domestic fowl, dark red and black, with bright yellow feathers at the root of the tail. Some had a yellow head with naked white patches on the ears.

About the jungle fowl my men told me a story which may or may not be true but there it is.

When I was on the small Lullabeer Doanea River, north of island 182, I was asked not to shoot any jungle fowl there, as I often used to for the pot, because in that particular island, a certain god, *Bandeao* or *Banadeo* by name, did not like it and repaid with the worst of bad luck anybody not taking his wishes into account. He was a little known god whose existence, in that part of the Sunderbunds, had been disclosed, in a dream, to a very holy headman of a distant village in the north. The god did not allow anybody to cut wood in this same island. I am not absolutely certain that this beautiful story had nothing to do with the anxiety of my men not to stay any more on that small river, where, during the night, we had heard two tigers roaring as I never heard one roar before or after. But as it was extremely hot there, in the middle of the day and fearfully dense jungle, and as I was on my way farther on, I obeyed the order of *Banadeo* very readily.

All the animals living in the Sunderbunds have to lead a special life under peculiar conditions. I saw monkeys drinking the brackish water; tigers, which are many, have to do the same and think nothing of swimming across rivers nearly half a mile broad. I saw this at the mouth of the Malancha, and had ample evidence of their having done so in many smaller rivers. Jackals, common on the northern border, are unknown further south, and may object to brackish water and swimming. Deer and wild boar are quite happy with both, even the pretty Fishing Cat (*Felis viverina*) which I found in island 169, must feel happy with it. But, I think, buffaloes and, I am certain, rhinos need sweet water.

Of buffaloes I have very little to say. There was not one to my knowledge anywhere south of Issuripore, but in the north where there is also dense jungle and several islands covered with thick jungle, there were one or two small herds of them. I am not certain that they were not tame buffaloes turned wild, after some cultivated parts had been given up. As the domestic water buffalo (and they were water buffaloes) is identical with the wild one, it is hard to tell; and I did not trouble much about them, seeing that I was going to Assam later. I just spent two or three days after them, and had proof of their high jumping capacities. Three of them when disturbed, jumped frog fashion into a river from a high bank, certainly twelve feet above water level. The splash was magnificent. I treasured the fine sight in my memory. Ten years later, when trying to spear hippopotami by the Aouash river in the Danakil country, a hippo that I had intercepted on his way back to the river and speared with a large Somali spear, took a clear jump from the bank into the river from a measured height of 14 ft. That was a sight by moonlight.

In January and February 1892, rhinoceros were to be found at only one place in the Sunderbunds as far as I know, and that is in islands 165, 172, 171, 170, 169. There may have been rhinos farther east or west, but here where there is a maze of forests, islands and rivers, I spent days and days tracking them. I penetrated this slough of deep slush and clammy heat, going through the most abominable mud-covered thorny thickets, without ever seeing an open space ten yards across. The rhinos lived there for one reason. In the middle of this jungle there was sweet water. How is it possible to explain such an occurrence in this delta, where two mighty rivers, the Ganges and Brahmapootra, have slowly filled up the Bay of Bengal with alluvial soil, washed down since centuries from the Himalayas, to a depth of seven hundred feet over a surface of many square miles? But the fact remains: some pools of sweet water are to be found in the jungle about fifteen miles south of Issuripore, while the whole country is surrounded by tidal rivers of brackish water and inundated with salt water.

The first rhino tracks that I came across were when after crossing the river Pizon Khalee, I was going up a steep mud slope. They were deep tracks, the hind foot stepping exactly into the spoor of the fore foot, the central toe boldly cutting the ground, and the two lateral toes just tipping it in hard places. Foot a little broader than long. Soft parts of the foot, behind and between the toes, very hard and without any wrinkles. In this character the Sunderbund rhino differs from other rhinos living on hard soil. The foot is decidedly broader than the girth of the leg as, even in sinking, as is the rule, over ten inches in mud, the leg itself does not touch the walls of the foot hole. The foot is lifted, and comes out absolutely neat and clean, without any drag of any sort. Inspection of the lower part of the hole shows that the weight of the body does not make it expand as would appear likely under the pressure. The animal must be extremely tough, and apt to a lot of work. The hind foot steps exactly into the print of the fore foot. It is a little smaller and more oval. It seems also that the hind foot rests on the ground at a little outward slant. The beast goes at a quiet slow walk, under the big trees and through the heaviest thickets, without paying the slightest heed to obstruction. The spoor is made in a regular zigzag line like a cat's track on snow.

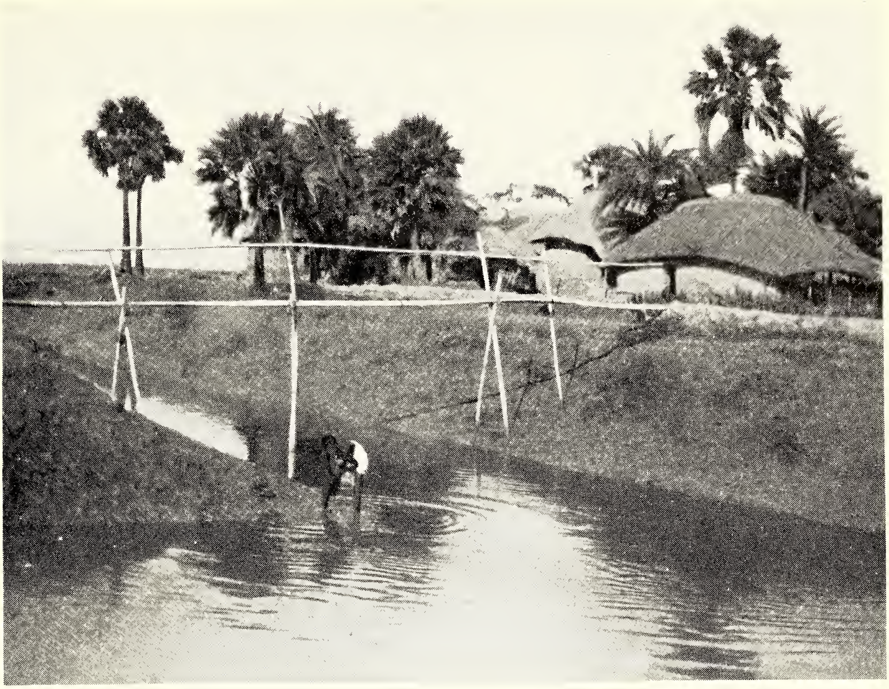
A rhino browses very steadily. He is quite at home. No flies to disturb him, he seizes the tips of branches in his stride without altering the position of his feet in any way. He does not trouble to move his head right or left to inspect his food. He does not pull at a branch sideways, as so many browsing animals do; the branch is crushed and cut sharp without a move of the head. His meal lasts until late in the morning, his tracks lie over the ones left by numerous crabs, which travel about mostly before nine in the morning. He does not rub against any tree but rather avoids them. When he goes into a thorny or leafy thicket, he does it as a needle piercing a cushion. The sort of tunnel left behind is hardly visible and, at most, three feet high, as the branches spring back almost exactly. After an hour's careful tracking I came to the conclusion that I had to deal with a very tough and hardy animal which was going to give me a lot of work and which might be found on the move at any time of the day. For the rest: the food specially selected by rhinos, the difference in the footprints of male and female, the surface of ground covered in an average day, the number of animals in the area of jungle inhabited, their peculiarities and minor habits and so on I had to trust to time to learn them. I was beginning a course of intensely interesting study.

I started it, in earnest, and kept at it steadily. There is no use in hurry. It is a mistake to jump to hasty conclusions. Everything is written, for a patient tracker in the footprints of an animal. In this terrible jungle, plodding along in deep mud with the temperature like a steam bath, in the close atmosphere of these deep forests, I kept for days and days on the track of these rhino coming on them several times at close range, in places where it was impossible to see anything. Once, when wet and tired after a long day, I saw, betwen branches and leaves, a long grey head only a few yards away. It had no horn—no trophy. Why shoot for the lust of killing only? The rifle just touching the shoulder came slowly down, the rhino went off unscathed; as I had suspected it was the Lesser one-horned Rhino (*R. sondaicus*) exceedingly rare! It is forty-two years ago now and I don't regret it, sport is not slaughter, killing a very rare animal, without a trophy as an excuse, is criminal.

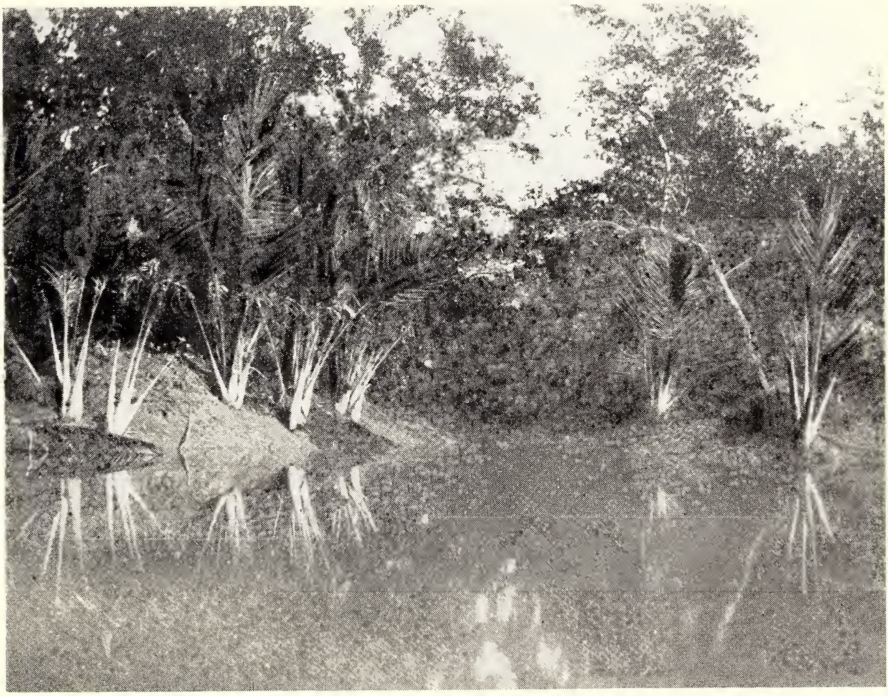
I should say that, at that time, there were only three rhinos in this part of the Sunderbunds—perhaps four at the most . They were all the same size, full-grown animals, without much to choose between them. They were generally on the move without following any beaten or regular track. My average day was this.

As early in the morning as the tide would allow, from my dinghy I inspected the banks of the rivers until I found a fresh track. If a little river through the jungle was available I used it as far as possible, and then made a detour across to come on the track again. If none was handy I landed and followed the spoor at once. Sometimes the track led under big trees where the going was a little better, oftener, through dense thickets of various sorts. At spring tides these were inundated and the whole vegetation, up to several feet, was smeared with dried mud which fell in a shower of dust, when forcing a way through. Some of the trees were rather like hollies with heavy thorny leaves, others might have been a sort of *Dracaena*: straight stem about the size of a man's arm from six to ten feet high, then a bunch of arched leaves fringed with hard thorns. Quantities of dead leaves projecting all along the stem were most objectionable. Often, the only thing to do was to go under, on all fours; but, with the mud, it was not pleasant, and the rifle had to be kept above ground.

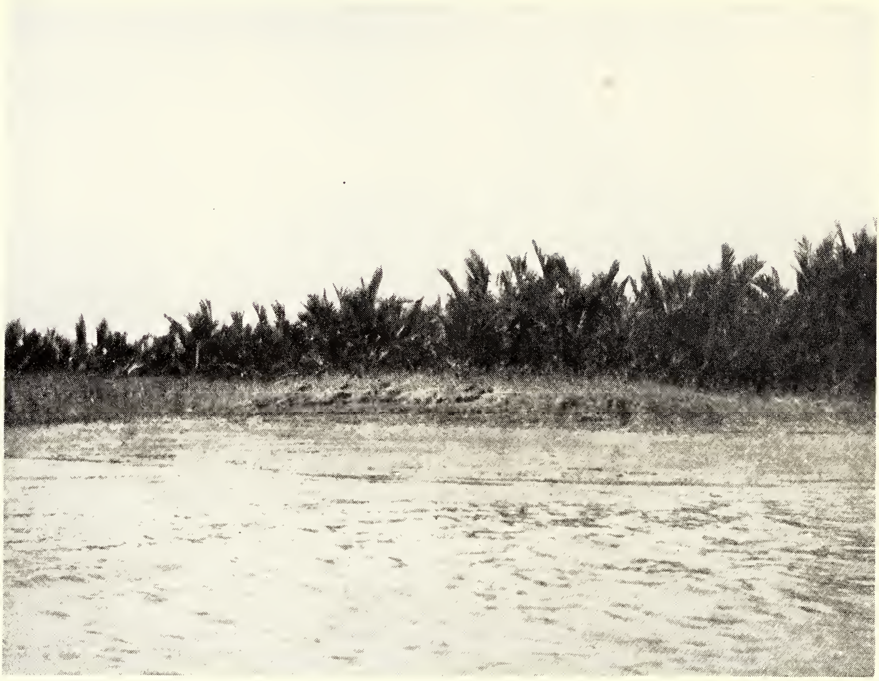
The rhinos travelled singly, only occasionally did I see tracks of two together, and that only for a short time. Following them led to the discovery of some strange ruins, near which I came across some small ponds of sweet water. They were the reason of the rhino's presence there. Under tall trees and in the middle of patches of thorny bushes, were some mounds of earth, slightly higher than the surrounding ground. It was so abnormal to find a dry place in the Sunderbunds that I examined these mounds more closely to discover what they could be. There were old decayed bricks rather like those found in the ruins of Issuripore. Some of the mounds were built in a row, almost in a straight line for about one hundred yards. On the other side of a small river, were one or two more. The vegetation, owing probably to a slight upraising of the soil, was a little different there. One tree, with an extremely hard brown wood and long oval dark green leaves, grew there. Another, overgrown with creepers, had been fairly choked: its dead trunk was visible through a network of ashy grey creepers which terminated high above in a magnificent canopy of green leaves. One of the mounds had been hollowed out by some animal which had dug a burrow, hardly



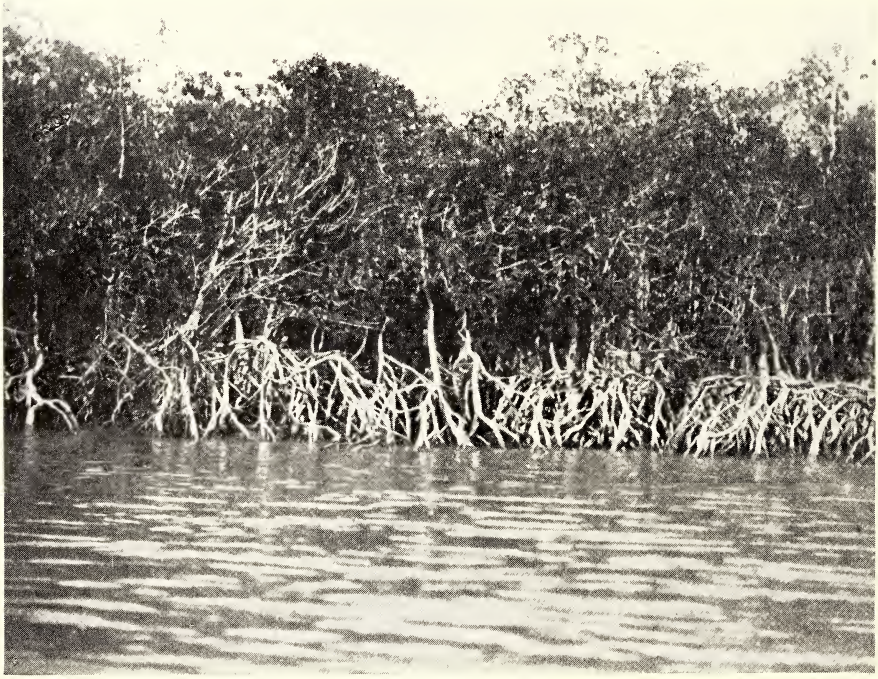
1892. North Sunderbunds—low tide—native dwelling with footbridge.



1892. A small river giving access to the interior of the jungle—low tide—big palms growing out of the mud.



Sunderbunds, 1892. Half tide mud bank with fringe of big palms.



1892. South Sunderbunds near the Sea. Malancha River—High tide.

bigger than a rabbit's. The soil all round was too hard and dry to bear any footprints.

For a very long time rhinos had wandered about the place. It was simply covered with and beaten flat by their tracks. Dung, which they don't seem to drop regularly in fixed places like the other rhinos, was to be seen there and also a few places where they had lain down. Some ponds of sweet water were scattered about, none more than a few feet across except one, much deeper than the others. This particular tank might have been twenty to thirty yards broad and of an unknown length as it disappeared under overhanging trees and creepers, and I could not go round it.

Waiting at night there was impossible, so close was the jungle. I tried several times to find a rhino there, either lying down, or standing motionless for hours, as they do, but never succeeded. I was afraid of disturbing them too much, as when disturbed, they go off for several days without coming back. It made me believe that they might have other sweet water drinking places somewhere in the unknown parts of the forests. If not, they may go without drinking for several days.

The river Pizum Khalee seems to be the centre of their wanderings. They often swam across it. I even saw unmistakable signs that they sometimes swam long distances up and down the river. One day a rhino went up river and fed on the leaves of branches overhanging the water. The depth at this place was certainly over ten feet. A long smooth furrow along the vertical muddy bank was proof of his rubbing against it and showed that he had kept in the river for over four hundred yards swimming along the bank. Several times I had proof of their prolonged swims.

It seems that they travel long distances in almost a straight line at a long easy stride without taking much care to keep to special runs. Arriving at a favourable place, they roam about over short distances turning over and over again on their tracks. As the jungle is very often extremely thick, tracking is difficult. Again, when leaving such a patch of jungle, they make in a straight line for another favoured spot which may be several miles away. But the proof that they travel to a known destination is that I never saw them going north or south but exclusively east or west. They know exactly where they want to go. I tracked them for five or six miles in a straight line several times. It was always the same long easy stride, keeping unerringly in the same direction. The difficulty of coming back to my boats, at the time when the tide would be right, did not allow me to see the end of their journeys.

The jungle was so extremely dense that my range of view was very limited—at the most under twenty yards. On several occasions I kept in close proximity to the rhinos for a fairly long time, following them, marching parallel with them, trying to head them. In this very close atmosphere it seems that scent does not travel far; so still is the air. I could hear them browsing, pulling their feet with a dull flop out of the mud, breaking dead branches in their stride, all very quietly and slowly. When quite near I took great care never to move except when they were moving themselves or munching, so that any possible noise might be covered by the sounds they were making themselves. Sometimes, when on all fours under cover, I happened to be nearer than I thought comfortable. Once I got a glimpse of a huge leg very near indeed. Another time some branches were shaken by a rhino very near my head. If I had only seen a part of the animal it would have been possible to guess where to shoot; but it was never possible to see one clearly. Certainly these rhinos are not quick tempered and apt to charge like the black African rhino or even the Assamese species. Any of these would have resented my close proximity. Instead of that, when after a while, one got suspicious it stood absolutely motionless for a long time, once certainly over ten minutes. I remained absolutely motionless also, wondering what would happen next. I found it extremely trying. Then with a rush of a few yards through the dense undergrowth, then a long stop again, then another rush, off he went at a long stride making a bee line for some distant jungle patch unknown to me. For at least three miles he went straight on, never galloping, but ambling, and putting his hind foot over, and cleanly in advance of the fore-foot.

One evening, when after tracking vainly the whole day, I was slowly paddling back to my boats, I heard a branch breaking quite close to the river bank. A rhino was leisurely following the margin of the river. I kept along the bank for a long time expecting him at any minute to show a bit of himself or even swim across. But he kept inside the deep jungle, never more than a few yards away, until, when it was pitch dark, he got a whiff of my wind. Then he stood motionless for a long while and after a short rush, stood again, then made another rush and went off for good. The next day I read these movements in his tracks. The dinghy was not much above ten yards from him when he got to know we were there. The first rush was not more than ten yards; when he stopped, he turned round as if trying to look behind him; the second rush was about forty yards. The tracks were wide apart as if, with the head up, he had been looking right and left over his shoulder, a common habit with all rhinos. Then he had come back a few paces along his track, and stood for a while moving his fore feet several times and, finally, he took a bee line, at a long easy stride, to some distant part of the forest. I tracked him for four hours without result. Some people would say that, when he turned on his track, he meant business and was ready to charge. I say: no. Many animals do this when disturbed without being much alarmed. They look over their shoulders or turn round to look behind when they stop. Sometimes, out of sheer curiosity, an animal will come back on its tracks, and may appear as though viciously waiting to catch the intruder. But it is curiosity not mischievousness. Animals do this when they don't know exactly what the cause of the disturbance is. When they start again, they turn sharp, head held low and sideways, gallop for a few yards, then break into a long trot, tail up or flourished rapidly, head carried high to look behind over their backs. After a while the head comes lower and the animal goes away at a steady trot or gallop. Buffalo, of every sort I know, act very often in this way. I do not mean to say that many an accident has not been caused by animals waiting by their track, in deep jungle, and charging the hunter following the direct one. But it is not calculated action as many people would believe, it is mere reflex and normal action. The animal wants to make out the cause of the disturbance, he stops and goes a few steps back. But a bulky brute does not turn sharp on his feet, he does it in a curve and that curve brings him out of the main track and alongside it; when resuming his flight he will often take a new line. Many an accident and many a rash conclusion is derived from this very simple manoeuvre. A wounded animal, or even a disturbed animal, may take the chance offered and charge viciously. In such a case, he but takes his opportunity, he does not make it as many people believe. If people want to go for so-called dangerous game they ought, first of all, to know better than keep blundering about, as is so often the case. I consider that these rhinos that I found in the Sunderbunds were not as quick tempered as other species. They had many a chance to come for me or turn 'difficult', but never made the best of such chances. The Assamese rhino would have been different though they are not to be compared with the African species. These last would have turned me out of this dense jungle in no time.

The opinion which I acquired slowly made me wonder if they were not another species. At the time, the problem of *Rhinoceros sondaicus* was not much discussed, forty-two years ago all these questions were not yet to the fore; but my suspicions so aroused made me observe them better.

One thing which struck me first was the complete absence of places where a rhino had been wallowing in the mud. I never saw any. They very rarely rubbed against trees as the other species so commonly do. This may arise from different causes; perhaps from an exclusively forest life. But in one place where one of them had been lying down I could faintly discern that the skin, where not rubbed and polished by the branches, was something like a mosaic, leaving on the mud a sort of network of little lines. That was queer. Then I found a tree where a rhino had rubbed his head and cheeks. In a case like this the marks start at the level of the head, held horizontally or raised, but some mud, sticking on the bark, showed that he had lowered his head almost to the level of the ground. That is generally evidence of an animal turning its head sideways and trying to scratch it over the nose. That could not happen if there was a horn, and a horn would make a mark on the bark of the tree, if the rubbing had taken place just behind it. But then he had rubbed both cheeks, one after the other, on both sides of the tree, and left no mark when, with his head very low, he passed his nose from one side to the other? And finally, as explained above, I got a glimpse of a strange profile at a very short distance. For the first and, I am sorry to say, the last time in my life I saw that long, grey, hornless head and everything was explained: these rhinos were *R. sondaicus*, they had no trophy worth having and shooting them was without excuse.

What has become of the Sunderbund rhinos now in spite of the extreme difficulty involved in their pursuit? They were then very few: I am certain of three, I consider that a fourth is probable, and that six is the maximum. They are probably shot out. Even when I was there, poaching was rife in the Sunderbunds. Boats coming to get firewood for Calcutta had generally a gun on board. Almost every two or three days I heard a distant shot somewhere in the forest: it meant food for the boatmen. I also met one small boat which came to beg for some water, on board were two men and two guns. They disappeared to the south. The Government in response to some, absurd but misplaced, philanthropic feeling, I have been told, gives fifty rupees as a reward for every tiger shot in the Sunderbunds. That is enough to start poaching to an uncontrollable extent. I do not intend to say that any regular rhino-shooting ever took place; but, certain it is, that any of the poachers meeting one of them either in the forest or, more probably, crossing a river, would take a shot at one. That is enough, wounded or killed it is one less, and there were none to spare. Nobody took the slightest notice: white men did not go out shooting much in the Sunderbunds in my time, I don't think many have done so since. What does it matter if one more of the rare animals of the old world is extinct? Still, amongst the most cherished souvenirs of many years big game shooting in the world, in spite of a great many drawbacks, these days in the strange stillness of the big Sunderbunds forests are among the best.

NOTES ON THE BIRDS OF THE SITTANG-IRRAWADDY PLAIN, LOWER BURMA.

BY

J. K. STANFORD, I.C.S., O.B.E., M.C., M.B.O.U., F.R.G.S.

These rough notes were made between April 1929 and November 1932 in various parts of the Henzada, Insein, Pegu, Pyapon, Maübin, Hanthawaddy and Thaton districts of Lower Burma. My excuse for putting them on record is that, since Oates published his *Birds of British Burmah* in 1883, practically no one has collected in the huge area which lies between the mouth of the Sittang on the East, and the hills which fringe the western side of the Prome, Henzada and Bassein districts.

The area is drained by four large rivers, the Sittang, the Pegu, the Hlaing (or Rangoon) river, and the Irrawaddy, and their tributaries. It is bounded on the east by the heavily wooded left bank of the Sittang, down the centre runs the line of the Pegu *yoma*, and along the western side the foothills of the Arakan *yoma*. Though a vast amount of swamp and forest land since Oates' day has been cleared and converted into corn land, though the southern half of the heavily-timbered Pegu *yoma*, running down to Rangoon, has long been stripped of all but its scrub and bush jungle, though the line of forest reserves which, in 1912, stretched from the Sittang to China Bakir and beyond, has become one endless paddy-plain, yet there are still enormous areas, difficult of access, which are, it is not too much to say, less known by naturalists now than they were in 1883.

There is now but a small remnant of the swampy forests bordering the Sittang which in 1883 formed a stronghold for Pelicans and Adjutants, in the breeding season. At the southern end of the plain, the remnants of the old primeval woodland, and of the forest avifauna which peopled it, still survives in the Zepathwe reserve near the sea. But despite these changes, rapid as they have been, there are still vast solitudes in the *yomas*, and along the seashore, as inaccessible and quite as little known ornithologically, as they were fifty years ago. The dense evergreen foothills of Insein and Pegu, covered with *wanwe* and *wathabut* (bamboo) jungle, the Lemyethna and Kyangin foothills bordering the Arakan *yoma*, covered with *kayinwa* (*Melocanna bambusoides*), which resembles, as someone described it, 'miles of corn fields grown to nightmare height', and the enormous area of tidal mud, intersected by creeks and fringed with mangrove and willow jungle (*Sonneratia apetala*) are still almost unknown to the naturalist. To give but two instances, Armstrong's Sandpiper (*Glottis guttifer*) has never been obtained by anyone in Burma or India since Doctor Armstrong worked the river near Elephant Point in 1875-1876.

Jerdon's Babbler (*Pyctorhis altirostris*) has not been recorded by any naturalist since Oates, in 1883, stated that it was 'very abundant in the Rangoon and Shwegyin districts'.

These notes are most incomplete, and the gaps in them will show Burma observers how much remains to be done. I started collecting in Henzada in 1930, with the assistance of Mr. E. Henricks, whose services were again lent me by the courtesy of the Bombay Museum authorities. Our task had to be dropped abruptly in February 1931 on the outbreak of the Henzada rebellion (which had been simmering for two months previously), and it could only be resumed in a partial manner later. I am indebted to Mr. Henricks and to his successor, Mr. W. Stubbs, for their painstaking work done often under very trying and difficult circumstances.

To Doctor C. B. Ticehurst, M.B., M.R.C.S., M.B.O.U, F.R.G.S., who has identified the skins sent home, and has at all times given me invaluable advice, my grateful acknowledgments are also due. His notes are given in square brackets.

Most of all, I regret that I had little or no opportunity to study the birds of that wild and lonely area lying between Elephant Point and China Bakir. As remarked above, it is probably the one place, in the southern part of the Pegu division, where the original forest avifauna of Lower Burma survives more or less unchanged, cut off, as it is, on one side by the sea and, on the other, by a hundred miles of paddy plain. I do not know of any area in Burma so rich in varied bird life, or in which the bird watcher is so sure to find his time and trouble repaid. Beyond the paddy land there is dense tree forest intersected by creeks winding through mangrove jungle, miles of streams [fringed with willow (*Sonneratia apetala*), and a form of sea holly], which debouch through open sandy dunes, or on to unending levels of sand and mud, and which are covered at low tide by tens of thousands of wading and water birds.

The rainfall in the area varies from 90 inches in the South-west to about 65 in the North and North-east.

The number of skins sent home is approximately 400, belonging to 166 species. Others mentioned were fully identified in the field, or in the case of some of the ducks and waders, shot and not preserved. In all 291 species have been noted, and of these 3 are new to Lower Burma.

In his paper on the Birds of Rangoon (J.B.N.H.S., vol. xxv, p. 358) Colonel Harington recorded 152 species, of which those seen by him and not found by me were

Prinia flaviventris,
Alseonax latirostris,
Hirundo smithii,
Arachnothera longirostris,
Pitta oatesi,
Pitta cyanoptera,
Gecinus occipitalis,
Hemicercus canente,
Dichoceros bicornis,

Cuculus micropterus,
Hierococcyx sparverioides,
Palacornis indoburmanicus,
Ketupa ceylonensis,
Scops bakkamoena,
Polioaëtus humilis,
Alsocomus puniceus,
Arboricola brunneipectus,
Turnix blanfordi.

Corvus coronoides subsp. JUNGLE CROW. ♀ 640.

Common, but only one was collected. Harington noted that where jungle crows take to living in or near towns and villages, they tend to breed smaller than those in the jungle. There is certainly considerable variation in size observable.

[It does not seem at all certain that our Indian jungle crows are races of the Australian bird (*coronoides*), or that the Burmese birds are inseparable from the typical Java form.—C.B.T.]

Corvus splendens insolens BURMESE HOUSE CROW.

Ubiquitous. Though they return to their breeding haunts in early February, they seem to start breeding much later, and I have found fresh eggs in mid-April.

I have seen crows flighting eastwards in January at dusk from the Henzada *yomas* at a very great height, and obviously coming from a considerable distance, in exactly the same way as Paroquets do. The noise made with their wings by a flock of *Corvus insolens* flying overhead, appears to be produced at will, in the same manner as a breeding male Lapwing can suddenly produce a resonant noise with his wings, when flying over an intruder.

21. **Urocissa erythrorhyncha magnirostris** RED-BILLED BLUE MAGPIE.

Local name:—*Hnget-aungma*. Common in the foothills of the Arakan *yoma* in Henzada. Harington and Wickham found it fairly plentiful near Rangoon and breeding at Taukkyan (Insein) in April, but I have not seen it there.

29. **Dendrocitta rufa kinneari** BURMESE TREE PIE. 501, 652.

Common in Henzada and Insein and occurs in the outskirts of Rangoon. A female shot in February showed signs of breeding. One seen on October 25th was just acquiring its new tail, the feathers on one side being complete, and on the other only half the normal length.

[This race is just recognizable on a good series. Single specimens cannot be differentiated. It was compared in the *Fauna* (i, 50) with *sclateri* (Chin Hills) but it is much nearer to *vagabunda* (Bengal) from which on a series it differs in having the head less dark, mantle less foxy-red and less contrasting with the head, and underparts less deep. A series of adults from Lower Burma ♂♀ measure: wing 140, 145-62; tail 220, 222, 236, 262, one 278. Tails run rather longer than in *vagabunda* but wing measurements are the same. Birds during their first year can be differentiated from adults by the less black flight feathers and by the pale tips to the tail.]

36. **Crypsirina temia varians** BLACK RACKET-TAILED MAGPIE. ♂♂♀ 605, 626, 651.

Not uncommon in the Insein and Henzada districts, even close to Rangoon. Those I saw along the Henzada *yomas* were in pairs in early February.

[Two ♂♂ measure: wing 118-122.5 mm.; tails 185, 195 mm.; ♀ wing 119 mm.; tail 187 mm.

The central tail feathers are less spatulate in the female than in the male. —C.B.T.]

37. **Crypsirina cucullata** HOODED RACKET-TAILED MAGPIE. ♀ 534.

Local name:—*Nabà-chu.*

I saw several in the northern part of the Henzada district near Pauktaing where *Argya gularis* also occurs. It may be a dry weather visitor, but in view of the fact that I saw one in Myitkyina in January 1934, and that

Argya gularis has also occurred outside its usual range (the dry zone), further observation is clearly necessary as to this Magpie's distribution in the province.

[Venning first pointed out that in three specimens of *cucullata* there were only ten tail feathers. This I can confirm on half a dozen more and also note that *temia* has only ten tail feathers. This is very remarkable as I know of no other member of the Corvidae which has less than twelve.—C.B.T.]

51. **Parus major cinereus** Indian Grey Tit. ♀ 55.

It was interesting to find, as Armstrong did in 1876, that this Tit was abundant in the 'tidal jungle' near the mouth of the Rangoon river. Not only do the willow trees along the creeks attract it, but the old and dead trees in the remnants of primeval forest, which form the Zepathwe and Pilakat reserves, are clearly favourite breeding grounds. I saw it nowhere else, and should describe it as a rare bird over the greater part of Lower Burma.

112. **Sitta castanea neglecta** Burmese Nuthatch. 444.

Not uncommon in the Henzada plain and in places very tame. It is partial to tamarind and *kokko* trees. I have never seen it in flocks as I have *frontalis*, nor have I any records from the rest of the area.

119. **Sitta frontalis corallina** Velvet-fronted Nuthatch. ♂ ♀ 623, 624.

I shot a pair on February 13th in the Henzada *yomas* which showed no signs of breeding, and saw a flock of six on the same date accompanied by Minivets and other birds. I have frequently seen this nuthatch moving about in small and very active travelling parties like Tits, mingled with other species.

128/129. **Garrulax leucolophus** subsp. White-crested Laughing Thrush.

Abundant in Prome but seems uncommon or very local in Henzada, as I saw only one small party near Shwelaunggyin in the *yoma* foothills in February. In Insein also it is local, and not found near Rangoon.

131. **Garrulax pectoralis** Black-gorgeted Laughing Thrush.

134. **Garrulax moniliger** Necklaced Laughing Thrush. 212, 505, 510, 511.

I have never been able to distinguish these two species in the field, and usually only by measurement in the hand. The only specimens obtained were at Kywezin (Henzada), where three shot in bamboo jungle in the *yoma* foothills were undoubtedly *moniliger moniliger*.

A male out of a pair shot at Aukkanyinmyaung in May 1932 on the eastern side of the Pegu *yoma* was identified as *moniliger fuscata*.

[An interesting problem in distribution yet remains to be solved with regard to this common bird. The *Fauna* gives the distribution in Burma of *moniliger moniliger* as 'Northern Burma or Northern Shan States', and of *moniliger fuscata* as 'South Central Burma to South Tenasserim'. Mr. Stanford's Kywezin birds are undoubtedly *moniliger* with white tips to the tail, which are buff in *fuscata*. In the British Museum are typical *moniliger* from Thayetmyo or 'Pegu' but others labelled 'Lower Pegu' are *fuscata*. Of birds labelled 'Toungoo', some are typical *moniliger* and some are more or less typical *fuscata*. Possibly *moniliger* is the hill form, but this needs working out.]

191. **Argya earlii** Striated Babbler. 3 ♀ 422, 586, 587.

The commonest bird of the Henzada riverine plain where Oates noted its abundance. It occurs in Insein, Pyapon, Maübin, and Pegu in the *kaing* grass areas, and was seen in family parties from December to July.

194. **Argya gularis** White-throated Babbler. ♂ ♂ 538, 551.

As already reported in the *Journal* (vol. xxxv, 15th November, 1932) I saw a few in the northern corner of the Henzada district at Pauktaing in January 1931 and obtained two specimens. This country approximates fairly closely to that of the dry zone and seems to be a continuation of the Prome-Tarokmaw ridge on the other side of the river.

In May 1932, I saw a party on the laterite ridge south of Mingaladon aerodrome about ten miles north of Rangoon on several occasions, and a single bird on the other side of the Rangoon-Prome Road. On September 25th, I saw a single bird on the 'General's Mile' at Mingaladon and on November 5th a party of four near Tadagale lunatic asylum, two miles further south. It is difficult for me to believe that these birds were not migrants or waifs. I have ridden almost daily through this country at all seasons of the year and think that if they were resident, or bred there, I must have observed them. It is to be hoped that other observers will look out for this species south of the dry zone.

[This bird is evidently the counterpart of, and is in the dry zone of Burma, the representative of *Argya caudata* of the dry area of India. Some ornithologists would therefore no doubt place it as a race of *caudata* since it replaces it geographically. To do so would in my opinion, be quite unsound. *A. caudata* ranges no further east than Western Bengal, and between its range limits and that of *gularis*, there is interposed the very different *Argya longirostris*. *Argya caudata* has never been proved to inhabit Burma; Blyth many years ago recorded it from Thayetmyo and Arakan (Birds of Burma, vol. i, p. 118), and the Arakan record is indicated as based on a specimen from Phayre. It is certain, I think, that a mistake has crept in, as in the Catalogue of the Asiatic Society, Blyth makes no mention of any specimen thence from Phayre.

The only other record is from K. C. Macdonald who records this bird as less common than *earlii* round certain jheels in Myingyan (J.B.N.H.S., xvii, 185). This record cannot be accepted without specimens to substantiate it.—C.B.T.]

228. **Timalia pileata jerdoni** Redcapped Babbler. ♂ ♀ 65, 216, 572.

Common in *kaing* grass jungle in Henzada and probably elsewhere, but it is a great skulker and is more often heard than seen.

232. **Gampsorhynchus r. rufulus** White-headed Shrike Babbler. ♀ 648.

A female was obtained in February in dense evergreen bamboo jungle near Kanazo in the foothills of the Henzada *yoma*.

234. **Pyctorhis sinensis** Yellow-eyed Babbler. 2 ♂ 219, 517.

Seen occasionally in *kaing* grass jungle in Henzada but a great skulker. I saw one feeding young on April 24th.

245. **Pellorneum ruficeps** Spotted Babbler. 1 ♂ 5 ♀ 79, 208, 515, 516, 543, 644.

A great skulker, nearly all I saw being in pairs where there is bamboo in more or less evergreen forest. Seems to spend most of its time hunting about on the ground.

[Birds from the Henzada foothills (100 ft. to 700 ft.) and from Ngapali at sea-level and Leindon, Thayetmyo, I think are all the same. The coloration of the upper part varies; in one from Sandoway it is quite as in the Thayetmyo bird. Two others from Sandoway shot the same day are greyer on the mantle; all have the dark marks at the side of the neck, and blackish marks behind the occiput as in *mandelli*, but have shorter wings and finer and paler breast markings, and the ear-coverts and flanks are paler. The type of *minus* came from Thayetmyo and is a very bad skin. Mr. Kinnear could not of course have seen the above series when (*Ibis* 1929, p. 294) he made *minus* a synonym of *subochraceum*. *Minus* ♂ 69.5-70 mm., ♀ 65.5-69.5 mm. *Mandelli* large series ♂ ♀ 67-74 mm., mostly over 70 mm. The bird referred to as '*ruficeps* subsp.?' from east of the Irrawaddy at Ngaphaw (Prome district) (J.B.N.H.S., xxxiv, p. 671) is quite different again and belongs to the *subochraceum* group, though it does not quite match any others available to me.

In the British Museum birds from Mount Victoria (Chin Hills), Mount Popa (Myingyan), Meiktila and 'Saw-Kawton Road' (?) I consider to be also *minus*. Birds from Mingin and Kani (Upper and Lower Chindwin) appear to be *mandelli*. Birds from Pegu, Rangoon, Toungoo, 'Tapraw', Karenni, 'Taroar' and 'Shan States' are *subochraceum* or a race of it.

The distribution of these birds still requires working out; it seems almost certain that *subochraceum* is a species and not a race of *ruficeps*.]

267. **Malacocincla sepiaria abbotti** Abbott's Babbler. ♂ ♀ 113, 114.

This is also a great skulker and though I believe it to be common in cane-brake and palm-fern jungle a few miles from Rangoon, it is very rarely seen. But for its Thrush-like song, it would rarely be detected. I shot a breeding male which was singing on December 27th, 1931, and on March 26th, 1932, shot a juvenile just out of the nest.

As the juvenile plumage has not been described, I may record that the legs were pinkish flesh, instead of brownish-flesh colour, and the lower mandible dull yellow instead of grey. The ferruginous on the tail and under-tail coverts is much less pronounced and the crown is streaked with yellow.

The adults crept all round me, churring harshly and occasionally singing, in a dense tangle of palm-fern.

283. **Mixornis r. rubricapilla** YELLOW-BREASTED BABBLER. 2 ♂ 51, 205, 218, 619.

This probably occurs all over the area but is a skulker in bamboo jungle and scrub, and rarely observed. I obtained one in the Pilakat reserve, one in the Henzada foothills and two on the eastern side of the Pegu *yoma*.

[The Henzada bird is a typical *rubricapilla*, and not the race I consider to be *sulphureus* which Mr. Stanford obtained near Prome.]

290. **Alcippe poioicephala phayrei** ARAKAN QUAKER-BABBLER. ♂ ♀ 610, 611.

Several seen along the Nyaung stream in evergreen jungle and bamboo near Kyibin (Henzada) on February 12th, 1931. One male showed signs of breeding.

[As I have already pointed out (Bull B.O.C., vol. l, p. 84) the acquisition of a small series of this babbler from its type locality, proves that the Assam race is not *phayrei* but must stand as *A. p. fusca*, Godwin Austen (type examined), from Garo Hills in British Museum.—C.B.T.]

362. **Ægithina tiphia** COMMON IORA.

Occurs over the whole area, but is nowhere very common.

368. **Chloropsis aurifrons** GOLD-FRONTED CHLOROPSIS. 3 ♂ 2 ♀ 209, 507, 544-45, 553.

Seems a common forest bird all over the area. I did not observe, or obtain, any of the other species of Chloropsis.

400. **Molpastes cafer burmanicus** BURMESE REDVENTED BULBUL.

Fairly common as far south as Rangoon wherever there is scrub-jungle.

412. **Otocompsa jocosa erythrotis** BURMESE REDWHISKERED BULBUL.

This bird seems to be much commoner in Insein and Henzada than it is in Prome, and is probably the commonest plains bulbul, and found right down to the sea in the Sittang-Elephant Point plain, where I have seen it in the holly scrub in the tidal creeks.

I have seen birds paired on December 8th, and it breeds in bamboo round Rangoon throughout February, being very common in the scrub south of Mingaladon.

413. **Otocompsa f. flaviventris** BLACK-CRESTED YELLOW BULBUL. 2 ♂ 31, 500, 520.

Common and apparently resident at a low altitude in both *yomas*. It is partial to streams bordered by evergreen bamboo jungle. A large flock appeared in my garden at Insein for about an hour on November 9th, 1929, and then moved southwards as if migrating. A single bird seen on the Secretariat in Rangoon on October 31st was also probably a migrant. Armstrong noted that it occurred even on the ships in Rangoon harbour, and Harington found it in the gardens of Rangoon from which, with the spread of building, it has long since disappeared. I have not seen it in the scrub jungle south of Mingaladon where four other species of Bulbuls are common.

[These two birds labelled males have wings of 87 and 87.5 mm. thus reaching the maximum given for the southern race *minor*. Most Pegu birds resemble Indian ones.—C.B.T.]

420. **Iole v. virescens** OLIVE BULBUL. ♀ 604.

Oates considered it a common forest bird in Pegu. The only one seen or obtained by me was one shot on February 11th near Kyibin (in Henzada).

427. **Pycnonotus finlaysoni finlaysoni** FINLAYSON'S STRIPE-THROATED BULBUL.

428. **Pycnonotus finlaysoni davisoni** DAVISON'S STRIPE-THROATED BULBUL. 2 ♂ 1 ♀ 2, 197-98.

Davisoni occurs in the scrub jungle on the laterite ridge between Rangoon and Mingaladon, but it is a great skulker and I have found it difficult to observe. This is close to the place where Davison, according to Oates, procured the type, though according to the *Fauna* (i, p. 413) this race was first described by Hume (*Stray Feathers,* iii, p. 301, 1895) from Arakan. I also saw a pair in the old Zepathwe reserve on February 18th close to the sea.

I obtained two *finlaysoni* in similar country on the laterite ridge behind Kawkadut where it was breeding. This is in Thaton district and presumably the Sittang-Rangoon river plain is the boundary between the two races. In this area, I heard several times a song rather like that of an *Acrocephalus* which seemed to be of this bird.

I saw a pair of *davisoni* on November 15th near Rangoon which from their behaviour undoubtedly had a nest or young close by. Several were seen in pairs in January, but after that they seemed to disappear and were rarely seen, though the liquid babbling alarm note was frequently heard in the cane-brake valleys of the scrub near Mingaladon.

In the *Fauna* the iris is described as 'pale to deep brown'. Oates correctly notes it as 'pale yellow' and the iris is most conspicuous in the field, as is a fulvous-yellow line just above the lores.

434. **Pycnonotus plumosus blanfordi** BLANFORD'S OLIVE BULBUL. ♂ ♀ ♀ 47, 485, 637.

Common and very widely distributed, but not a forest bird. A female obtained on February 14th was about to breed and a nest in bamboo on June 15th contained half-grown young.

439. **Microtarsus melanocephalus** BLACK-HEADED BULBUL.

442. **Microtarsus cinereoventris** GREY-BELLIED BULBUL. 2 ♂ 3 ♀ 3, 4, 10, 46, 64, 498, 499.

Melanocephalus is common in the cane-brake and scrub jungle between Rangoon and Hlawga. On January 1st, 1930 I shot a female *cinereoventris* sitting beside a male *melanocephalus* while the latter was singing to it. I also obtained this bird in the Henzada foothills in company with *Otocompsa flaviventris*. A male *melanocephalus* seen courting on February 16th sat at right angles to the female and bowed repeatedly up and down on a telegraph wire.

492. **Saxicola caprata burmanica** BURMESE STONECHAT. ♂ ♀ 478, 598.

Common and distributed over the whole area, except in the Sittang paddy-plain where I never saw any. On February 8th most seemed to have paired.

497. **Saxicola torquata stejnegeri** JAPANESE BUSHCHAT. 582.

Common over the whole area down to the sea from November to April. I noticed on January 30th, 1931, while motoring across the paddy-plain near Danubyu, that males of this species were to be seen every hundred yards along the road for six or seven miles but no females.

498. **Saxicola torquata leucura** WHITE-TAILED BUSHCHAT. 3 ♂ 3 ♀ 423-4, 450, 452, 580-1.

Seems common in Prome, Henzada and North Insein but is confined to the riverine area where pea-fields or *kaing* grass occur, exactly the same country as the Striated Marsh Warbler haunts. I have seen birds obviously paired in early January, and young on the wing on May 21st. A male with enlarged gonads was shot on February 3rd.

501. **Oreicola jerdoni** BUSHCHAT. ♂ 596.

I shot one on February 8th, 1931 in *kaing* grass at Leikchaung near Henzada. As Oates thought, it appears to be a bird of 'extreme rarity' in Lower Burma.

520. **Enicurus immaculatus** BLACK-BACKED FORKTAIL.

Occurs on the *yoma* streams in Insein and Henzada. I did not collect any.

538. **Cyanosylvia suecica robusta** CHINESE RED-SPOTTED BLUE-THROAT. 18, 72, 134, 169.

Seen both in Insein and Henzada. On the great Sittang plain it is a common bird of the open stubble but very shy, and all the view one gets of it is of a dark bird flitting away some distance off. If watched on the ground, its robin-like carriage and eyestripe are noticeable. I have seen birds in the Yandoon Island as late as April 23rd.

542. **Calliope calliope** Common Ruby-throat. 504.
The only one seen or shot in four years was one obtained by Mr. Henricks in scrub-jungle at Htugyi (Henzada) on January 12th, 1931.

559. **Copsychus s. saularis** Magpie Robin. 496.
Common and occurs right down to the sea in the scrub-jungle along the tidal creeks.

563. **Kittacincla malabarica indica** Shama. 22, 23, 512.
Common in both districts, but a bird of dense bamboo jungle and seldom seen. Eggs were found in April and May.

[There seems no doubt that Burmese and North Indian birds are not the same as birds from South India, as they have considerably shorter tails, ♂ 138-162 mm. against 160-200 in South India. Mr. Baker named this northern bird (*Fauna*, ii, p. 118) *indica* distinguishing it from Malayan birds which he called *macroura*. As he described and named a bird from Bhutan, his name must stand though he did not distinguish the North Indian bird from the southern one; *indica* is not a pure renaming of *malabarica* as Mr. Kloss has suggested (*Ibis* 1931, p. 338).—C.B.T.]

581. **Turdus obscurus** subsp. Dark Thrush. ♂ ♀ 621, 634.
I obtained three solitary birds in scrub-jungle (*a*) near Nyaunggon, Insein district in January 1930; (*b*) on February 13th, 1931 near Kyibin in Henzada; (*c*) on February 14th, a few miles from Kyibin at Legongyi. Of the first only a wing was preserved. One was with pipits and *Motacilla alba* at a pool in a stream and flew silently up into the jungle, and sat there motionless for a long time. The last also, when disturbed flitted away under a bush and remained motionless. The stomach of this bird contained fragments of dead leaves and ants.

587. **Geokichla c. citrina** Orange-headed Ground Thrush.
Not seen, except for a solitary bird on the Thanat stream in Insein in October 1929.

610. **Monticola solitaria affinis** Burmese Blue Rock Thrush. ♂ 600.
Not uncommon in the cold weather and I have seen it in the middle of Rangoon.

[Under the name *affinis* Blyth described from Tenasserim a bird with more or less chestnut on the underparts. Such birds are common in Burma. The Chinese form (*philippensis*) has the underparts, from breast to undertail coverts, chestnut, while *pandoo* has none at all. Between these two extremes, all intergradations are to be met with.—C.B.T.]

614-615. **Myiophoneus temmincki** subsp. Whistling Thrush.
I saw a pair on the Nankatu stream near Kyibin (Henzada) in the *yoma* foothills in February 1931. Otherwise I did not observe this bird in the area and obtained no specimens.

639. **Siphia parva albicilla** Red-breasted Fly-catcher.
Common from September to March over a great part of the area.

659. **Cyornis rubeculoides dialilaema** Salvadori's Blue Fly-catcher. ♂ ♀ 447, 618, 647.
I obtained one in December and two in February in bamboo jungle along the Henzada foothills.

665. **Eumyias thalassina** Verditer Fly-catcher. ♂ ♀ 427, 467.
I shot two in Henzada and did not observe many elsewhere.

674. **Anthipes olivaceus poliogenys** Brook's Fly-catcher. ♀ 647.
I shot one at Kanazo near Chondaung in the Henzada *yoma* on February 16th, 1931. It was not shy and sat near me like a Robin for some time in dense evergreen jungle.

679. **Culicicapa ceylonensis** Grey-headed Fly-catcher.
Fairly common in the cold weather all over the area, and a bird of open woodland.

689. **Tchitrea paradisi** Paradise Fly-catcher.
In view of Oates' statement that this bird 'occurs in large numbers in September and October' in Pegu, I looked out for it, but the only one observed

was a single female which appeared in my garden in Rangoon on October 17th, 1932.

693. **Hypothymis azurea styani** Northern Indian Black-naped Fly-catcher. 52.
Common in the Henzada foothills in February 1931, and also in the cold weather near Insein.

701. **Rhipidura aureola burmanica** White-browed Fantail Fly-catcher. ♀ 539.
Not uncommon, though only one was obtained.

[703.? **Rhipidura albicollis** vel. **javanica ?** White-throated or Java Fantail Fly-catcher.
I noted one of these species as common in the Zepathwe reserve near the sea, and all I saw in February 1932 were in pairs, or single birds. The supercilium in the field is practically invisible, and the bird in the field looks completely black except for a white line on the throat and the tips of the tail feathers. I regret not having collected any specimens as this bird was very partial to mangrove jungle, in which situation Davison found *R. javanica* in Mergui (B.B., i, 267). It is to be hoped that specimens of the Fantail Fly-catcher occurring on the Hanthawaddy coast will be forthcoming ere long. I assumed at the time they were *albicollis* and was unfortunately unable to return to this area to make certain.]

711. **Lanius colluroides** Burmese Shrike. ♂ 537.
Occurs in winter in Henzada but south of this it is by no means common.

712-713. **Lanius nigriceps** Black-headed Shrike.
Despite Oates' remark that it is resident in Burma and 'far commoner in the rains', I am satisfied that over the greater part of the area dealt with, this large and distinctive bird is now very uncommon. In 1931-1932 I kept a very close watch on the Shrikes and in the huge area covered only saw one, a single bird near the coast at Kamakalok. In ten days in August 1931 at Kalaw, Southern Shan States, I only saw one, where *colluroides* was very common.

720. **Lanius cristatus** Brown Shrike. 2 ♂ 2 ♀ 540, 542, 555, 575.
The common Shrike of Lower Burma from early September to April; its harsh swearing note can be heard all day long in and around Rangoon.

724. **Hemipus p. picatus** Black-backed Pied Shrike. ♂ 603.
Not seen except for a male shot in the Henzada foothills in February which showed signs of breeding.
[Typical *picatus*, which is slightly smaller than *capitalis*.—C.B.T.]

729. **Tephrodornis pondicerianus** Common Wood Shrike. 217, 552, 627.
Apart from a single bird shot on the eastern side of the Pegu *yomas* at Dodan on 10th May, 1932, few Wood Shrikes were observed over the greater part of the area, but I obtained males about to breed on January 23rd and February 13th in Henzada.

734. **Pericrocotus speciosus fraterculus** Burmese Scarlet Minivet. ♀ 622.
I collected very few minivets and found them difficult to distinguish in the field. The only one shot of this species was accompanying a travelling flock of Velvet-fronted Nuthatches and other birds.

744. **Pericrocotus r. roseus** Rosy Minivet. 446.
I shot one out of a large flock at Inbin (Henzada) in December 1930, the only ones identified for certain.

746. **Pericrocotus peregrinus vividus** Burmese Small Minivet. 13, 14, 27.
This was the common Minivet of the woodland west of Elephant Point, nearly all being seen in the 'Kambala' trees. Armstrong noted its abundance along the coast.

754. **Lalage melaschista avensis** Pale Grey Cuckoo Shrike. ♂ 115, 548.
Only odd birds seen both in Insein and Henzada, one of which in very worn plumage was shot at Kyetpyugan on March 25th.

758. **Graucalus macei siamensis** Siamese Large Cuckoo Shrike. ♂ 517.
A forest bird and very local in Henzada and Insein. Partial to teak jungle.

763. **Artamus f. fuscus** Ashy Swallow Shrike. ♂ ♀ 433, 588.
Only seen in small numbers except at Inbin on December 27th when a large flight appeared at dusk and disappeared into a leafy tree to roost.

[There seems to be very little variation in this species. Birds from North India, Madras and Burma are indistinguishable.—C.B.T.]

767-769. **Dicrurus macrocercus** Black Drongo. ♂ ♂ 434, 569.
In the cold weather this bird gathers at night in amazing numbers to roost in bamboo near Rangoon. Until 1931 I was under the impression—as apparently was Oates—that it was 'either absent or very rare' in Lower Burma after March ('January to October', Oates) and in his day it was apparently not known to breed.

A number of pairs undoubtedly bred in tamarind, gold mohur and other trees near Henzada in 1931. I saw a bird sitting in May, and on May 30th two young drongos just out of the nest. Another nest was high up in a huge tree in my garden. All these birds seemed to be extraordinarily silent and self-effacing at this time of year, and a close watch had to be kept to find them at all.

In 1932 I noticed Drongos near Rangoon till late May 1932 after which they disappeared, and breeding pairs were seen in the Yandoon Island in late April. I also saw pairs I suspected to be breeding on the Thanatpin-Kamase Road in Pegu in April. This bird's status in Lower Burma needs working out.

771. **Dicrurus leucophaeus** subsp.? Grey Drongo.
773. Drongo. 12, 13, 17, 69, 519, 620.
I obtained a few specimens of this puzzling species both in Henzada and Insein, but not enough to throw any light on the distribution of the races, nor did I see any breeding. I got the impression that the same bird in different lights presented considerable apparent variation in colouring, most as far as I could see being of the pale variety, though some seen in the grounds of the Rangoon University at close range in early November had very dark cheeks, wings and back, with the pale breast noticeable by contrast.

A further large series is necessary to determine the race.

780. **Chaptia aenea aenea** Northern Bronzed Drongo.
This is a forest bird and occurs in the foothills of the *yomas* on both sides.

[The Bronzed Drongo is one of those species which exhibits a smaller race at the end of the arc South India-Malaya. Pegu birds are nearer the typical race (wing up to 126 mm.), than to *malayensis* but are slightly intermediate as one might expect.—C.B.T.]

782. **Chibia h. hottentotta** Indian Hair-crested Drongo. 612, 617.
Occurs all along the Henzada *yoma* from Tonbo in Prome southwards. It seems to be a forest bird and I saw few near Rangoon, but a party of five which were seen in the University Estate on November 5th were probably migrants.

[The long hairs on the head of this bird do not spring from the posterior part of the crown, as has been stated, but from the forehead. The first year bird has less glossy tail and wings, and less curled outer tail feathers, as well as shorter frontal hairs than adults. 5 ♂ wing 161-168 mm.—C.B.T.]

788. **Dissemurus paradiseus rangoonensis** Burmese Large Racket-tailed Drongo. 116.
Common throughout the area wherever there is fairly dense woodland and is still seen in and near Rangoon. It struck me as being very abundant on the western edge of the Pegu *yoma*.

797. **Acrocephalus arundinaceus orientalis** Eastern Great Reed Warbler. 2 ♂ ♂ 23, 129, 173, 528.
I obtained one skulking in *kaing* grass in Henzada on January 18th and each small tank on the Sittang Plain held one or two of these birds throughout the open season. One was shot while singing, and I heard others, in

bushes far out on the plain of the Yandoon Island, at the end of April 1932. Possibly they breed here in the rains.

[*Locustella?* I frequently flushed undoubted Grasshopper Warblers in the Sittang Plain, especially out of the tufts of tall grass growing between the paddy-fields, but they rarely offered one a chance to shoot and would dive into the undergrowth at one's feet and disappear like a mouse.]

814. **Orthotomus sutorius patia** Burmese Tailor Bird. 56.

Common and breeds in the gardens of Rangoon, but I only collected one specimen.

825. **Cisticola juncidis malayana** Streaked Fantail Warbler. 2 ♂ 2 ♀ 468, 469, 480, 530.

Seems fairly common.

827. **Franklinia gracilis** Franklin's Wren Warbler. ♂♂ 206, 207.

The only ones seen for certain were males obtained—apparently about to breed—in paddy-cultivation on the edge of forestland in Pegu—east of the *yoma*—on May 10th.

828. **Franklinia r. rufescens** Beavan's Wren Warbler. ♂♂ 653, 654.

Mr. Henricks obtained two males near Legongyi on the edge of the Henzada *yoma* on February 17th.

836. **Megalurus palustris** Striated Marsh Warbler. 2 ♂ 1 ♀ 477, 577, 663.

Extremely common in the Irrawaddy-Sittang Plain wherever peafields, or rough grass and cane-grass occur along streams. Individuals were in full song on December 8th.

839. **Phragmaticola aedon** Thick-billed Warbler. 2 ♂ 2 ♀ 491, 535-36, 549.

A number were shot in Henzada in January and February, mostly in bushes near water.

852. **Phylloscopus affinis** Tickell's Willow Warbler. 177.

I shot a single bird in tamarind scrub near Prome on 17th February, 1929.

860. **Phylloscopus fuscatus** Dusky Willow Warbler. 5 ♂ 2 ♀ 16, 174, 176, 493, 494, 495, 518, 564, 565.

I obtained three in Prome in 1929 and most of those seen in Henzada were of this species. They were usually in scrub jungle near pools, but two were in peas and high grass and in this situation, with their low 'chuck'-ing note and skulking movements, looked much like *Acrocephali*. It was also common in the Zepathwe reserve near the sea, and along the coast.

[In a series of this warbler one can see differences in the colouration of the upper parts, some being browner, others greyer. This difference may possibly be due to age and it would not be safe to recognise any races on birds in their winter quarters. I have seen no specimens of *homeyeri* nor of *altaicus*.—C.B.T.]

876. **Phylloscopus nitidus plumbeitarsus** Middendorff's Willow Warbler. 502.

Mr. Henricks obtained one on January 12th at Htugyi in Henzada.

943. **Prinia inornata blanfordi** Tenasserim Wren-Warbler. 2 ♂ 2 ♀ 225, 470-74, 523, 562-63.

Common, usually in grassland near water, but occasionally in bush jungle in quite waterless grazing grounds.

[I do not think that *burmanica* (type locality Mandalay) is a recognisable race. The type and two others from that locality were obtained in June and are in somewhat worn breeding dress. There are also available birds in similar dress from Maymyo in August. This series does not differ in colouration from a series of Pegu birds obtained in July. It is said that *blanfordi* (type locality Toungoo) never attains a black bill in the breeding season, and possibly this is quite correct, but, although the type of *burmanica* has a black bill, none of the rest of the series has, so his distinction falls to the ground also.

Winter birds from Mandalay district are badly needed. 4 males from Henzada: wing 50.5-53 mm., tail 69-76 mm. (winter). 2 females from Henzada: wing 46.5-50, tail 63-66 mm. (winter).—C.B.T.]

950-51. **Irena puella** subsp. Fairy Blue Bird.
Not seen apart from one or two in the Henzada *yomas* at about 1,000 ft.

955. **Oriolus chinensis tenuirostris** Burmese Black-naped Oriole. ♂ 556.
Few Orioles were collected. This was the only one shot in Henzada and seemed to be the common Oriole round Rangoon.

964. **Eulabes religiosa** subsp. Indian Grackle.
Not uncommon in the *yomas* on both sides but I have never seen it in the plains. A forest bird.

972. **Psaroglossa spiloptera** Spotted-winged Stare. ♂♂ 601, 602.
The only ones seen were a large flock on a *Bombax* tree near Kwingauk (Henzada), on February 11th. This flock presented a remarkably beautiful appearance, as each bird was sitting, in a curiously upright posture, on the top of a tree, with the chestnut throat gleaming in the sun.

This is a bird only occasionally seen, and its movements are all too little known. Oates never met it.

[This bird is very variable in the male plumage. The type of *assamensis* from the Khasia Hills is an exceptionally deep-coloured bird and there are very few like it in the British Museum. From Assam, however, there are a great many birds which are not different from Western Himalayan birds, and, therefore, I cannot recognise *assamensis* as a tenable race.—C.B.T.]

987. **Sturnia malabarica nemoricola** Grey-headed Mynah. ♂♂ 522, 568.
Mostly seen from October to April but certainly breeds in Insein. It is very partial to feeding on the branches of mango-trees.

[This race varies very much in the colouration of the underparts and, no doubt, pink-breasted birds, such as one of these males from Henzada with black primary coverts, have given rise to the old records of *malabarica* in Burma. This bird is not distinguished from females of *malabarica* but is paler than any male of that race.—C.B.T.]

996. **Acridotheres t. tristis** Common Mynah.
Very common and resident. It is the only bird I know which habitually walks about *singing* while looking for its food.

999. **Æthiopsar fuscus** subsp.? Jungle Mynah.
A common bird all over the area, and even in outer Rangoon; I have seen very large gatherings at roosting time at the Tadagale sewage farm, and in *kaing* grass and bushes near Henzada.

1007. **Sturnopastor contra superciliaris** Burmese Pied Mynah. ♀ 558.
Common and resident.

1011. **Ploceus infortunatus burmanicus** = **passerinus** auct. Eastern Baya. ♂ 429.
I did not collect any breeding Bayas. A non-breeding bird shot at Kyangin (Henzada) in December was the only one obtained.

[This, unlike those collected by Mr. Stanford at Ngaphaw, Prome District, undoubtedly belong to this species and not to *philippinus*. As I have already pointed out, the name *passerinus*, which has been used for this weaver, as well as *atrigula* and *baya*, are synonyms of *philippinus*.—C.B.T.]

1015. **Ploceus manyar** Striated Weaver Bird.
I saw a few but did not collect any, and am unable to define the bird's status in the area.

1016. **Ploceëlla chrysaea** Golden Weaver Bird. 579.
Common. I saw a colony breeding on toddy palms in Henzada on June 12th and another colony of nests in a small acacia tree in the Rangoon Turf Club stables quite regardless of the constant disturbance of horses and men within a few feet of them. In Prome it breeds in reed beds with *Ploceus infortunatus*.

1020. **Munia atricapilla rubronigra** Northern Chestnut-bellied Munia. ♂ 488.
Common. In Henzada it was still in flocks in mid-June but I found many nests in the third week of July. In Insein I have seen birds building

as late as November 1st. Bushes or *kaing* grass clumps close to water are the favourite situations.

[Typical Nepal birds (*rubronigra*) have the belly and undertail coverts black, whereas Malay examples (*atricapilla*) have these parts sullied chestnut. Nepal birds are larger, wing 55-56 mm., against 52-53 mm. in Malay birds. A series from Pegu measures 52-56 mm. and not only do they show the extreme measurements of both races but every intergradation in the colour of the underparts. They are in fact, exact intermediates between the two races.

1025. **Uroloncha striata subsquamicollis** White-backed Munia. 4 ♀ 629, 632.

In Henzada it is either rare or very local and was not seen elsewhere. I shot four out of a flock near Kyibin feeding on seeds of *Cephalostachyum pergracile*. Later, on May 2nd, I saw a pair building in a bush in the bazaar quarter of Henzada town and on May 22nd another pair was collecting nesting material in my garden. This struck me as unusual, as this munia is normally a forest munia and very rarely seen elsewhere.

[I leave these for the present as *subsquamicollis* pending revision of the group.]

1032. **Uroloncha punctulata subundulata** Burmese Spotted Munia. ♂ ♀ 425, 426.

Common, and breeds on houses even in Rangoon. I have seen pairs building in late November when most Munias were in flocks and have also seen flocks as late as mid-June.

[This very difficult species of munia wants revising. In the meantime I leave these Burmese birds under the name given to the Assam race. Baker recognised this race in the *Fauna* (iii, 92) but in the synonymy (vii, 223) it is sunk as a synonym of *punctulata*.—C.B.T.]

1037. **Amandava a. flavidiventris** Burmese Red Munia. 3 ♂ 463-4-5, 599.

Common and winters. Seen in flocks up to mid-June. A bird of *kaing* grass.

[I certainly should regard this bird as a race of the Indian Red Munia. Outside India there are such obvious gaps in the distribution of *A. amandava* that it seems certain that where it occurs, it must have been introduced.—C.B.T.]

1097. **Passer domesticus nigricollis** Burmese House Sparrow. ♂ ♀ 437, 438.

Those obtained were from a breeding colony at Inbin (Henzada) in December. This sparrow is very local all over the area, *montanus* taking its place as a house-sparrow, and in Henzada it is more often seen round fishing huts and near the river where, I suspect, it nests in the holes made by Sand Martins. I have seen both *domesticus* and *montanus* in large flocks in mid-June.

1102. **Passer montanus malaccensis** Indian Tree Sparrow. 6.

This is the true house-sparrow throughout the area and far more abundant and less shy than *domesticus*. It seems to nest at all seasons, but mainly from August to November. Harington's description of it as 'partially migratory, disappearing in the middle of the rains and returning in November' is not now true of the Rangoon district.

1108. **Passer flaveolus** Pegu House-Sparrow. 3 ♂ 1 ♀ 449, 492, 559, 560.

Common in Henzada and winters. Breeds in bungalows in company with *montanus*. Not common in Insein.

1120-1. **Emberiza fucata** subsp. Grey-headed Bunting. 1 ♂ 4 ♀ 66-68, 133, 177.

I saw one in Henzada on April 26th with a flock of *aureola* and found it common in the Sittang-China Bakir plain. It is a shy bird of the stubble and easily overlooked, unless specially searched for, but in the Yandoon Island, where water is scarce, it is very familiar and comes close up to the cultivators' field huts. In April, besides the chestnut cheek-patch, the chestnut scapulars are very noticeable in the field.

1131. **Emberiza aureola** YELLOW-BREASTED BUNTING. 3 ♂ 2 ♀ 171, 191, 428, 479, 660.

Very common from October to early May. Roosts in very large numbers in the bushes fringing streams. In late April many old males are completely black about the lores and cheeks and the pectoral band is very pronounced, but the rest show great individual variation.

1148. **Riparia paludicola chinensis** INDIAN SAND MARTIN. ♂♀ 489, 591.

I have never so far been able to detect *ijimae*. Many are breeding by November, but I have shot non-breeding females in January. It is apparently resident as I have seen large flocks in June and July.

The young of this bird when on the wing, appear to show a good deal of white on the rump, due to the pale edges of the feathers.

1153. **Hirundo rustica gutturalis** EASTERN SWALLOW. 4 ♀ 117-18, 201, 557.

1154. **Hirundo rustica tytleri** TYTLER'S SWALLOW.

Local name: Pyan-hlwa.

As Oates did, I have noticed individuals of *gutturalis* almost throughout the year, except possibly from June 1st to July 15th. I have seen a good many *tytleri* both in November and April with rich chestnut flanks and belly, but failed to obtain any in Lower Burma.

1159-63. **Hirundo daurica** subsp. STRIATED SWALLOW. 2 ♂ 1 ♀ 457-8-9.

Very common in the cold weather and a jheel-haunting bird, in Lower Burma, which does not appear to breed. I have seen individuals in mid-July.

(I kept a close lookout for *H. smithii* which was obtained near Rangoon in Oates' day, and recorded by Harington, but failed to detect it.)

1170. **Motacilla alba ocularis** STREAK-EYED WAGTAIL. ♂ 184.

I shot one near Yandoon (Maübin) on April 25.

1173. **Motacilla alba leucopsis** WHITE WAGTAIL. 1 ♂ 3 ♀ 484, 497, 649, 650.

All obtained in Henzada were of this race and it is common until about mid-March.

1176. **Motacilla flava simillima** GREY-HEADED WAGTAIL. 8 ♂ 7 ♀ 134, 174-5-6, 182, 186-7-8, 200, 210, 451-3, 521, 660, 662.

All obtained in Henzada were of this race, and occurred up to early May. In the hot weather of 1932 I obtained a further series in April and May in Yandoon (Maübin), Kyaikto (Thaton) and in parts of the Pegu division, two of which from Maübin were identified as *macronyx*. The majority, after very careful observation with powerful glasses at short range, were noted as having 'dark greyish head and nape, lores, cheeks and ear-coverts almost black, throat and breast bright yellow, tail very dark. A few birds with paler heads have a faint streak behind the eye.' A male in very fresh plumage (175) had the tip of the chin pure white and a pure white patch behind the gape. There is no doubt that none of the full plumaged males in the field seem to show any trace of a supercilium which is supposed in the *Fauna* to be characteristic of *flava*. In Lower Burma, the Yellow Wagtail is not a water-hunting bird: the great majority feed on the dry grassy uplands or far out on the paddy plain. In Maübin they follow the plough. On April 24th I saw many large flocks flighting to roost in Yandoon.

[These birds are of the same type of *flava* as were in the Prome collection and which, for the present, I keep as *simillima*. They resemble *thunbergi* but have slightly longer bills. The supercilium is absent in some and slightly indicated in others. This may be pure individual variation.—C.B.T.]

1174. **Motacilla cinerea caspica** EASTERN GREY WAGTAIL.

Common from late September to March and I have frequently seen birds feeding on laterite roads far from water.

1181. **Motacilla c. citreola** YELLOW-HEADED WAGTAIL. ♂♀♀ 182, 183, 430.

This is the real water-wagtail, being a bird of jheels and rivers, and rarely seen far from water. It occurs all over the area and I have twice seen large numbers on the Irrawaddy flocking at roosting time, once as late as April 25th.

1182. **Dendronanthus indicus** FOREST WAGTAIL.

By no means uncommon, even in the 'Suburban Development' area near Rangoon, where Harington describes it as a rare winter visitor. I have only noticed it from October to March and saw it in bamboo jungle, dry deciduous jungle in the Henzada *yomas,* and in mango clumps. It has a faint single note which is difficult to locate, and when flushed flies into a tree and much resembles a Tree Pipit.

1186. **Anthus hodgsoni** subsp. TREE PIPIT.

A winter visitor and nearly always found in the shade of tamarind trees, though occasionally seen in bamboo. Leaves in early April.

1193. **Anthus r. richardi** RICHARD'S PIPIT.

Common all over the area. In the hot weather when motoring at mid-day along a road through the Sittang Plain, where small trees have been planted at regular intervals, I noticed single Pipits sitting in the shade of each tree for a distance of three or four miles.

In 1931 some remained until the first week in May.

1195. **Anthus richardi rufinus** INDIAN PIPIT. 2 ♂ 4 ♀ 431, 471, 473, 483, 659.

Very common. A male shot on February 18th had enlarged gonads and I found a sitting bird in mid-April.

1199. **Anthus cervinus** RED-THROATED PIPIT. ♀ 33, 59, 124-5, 222.

In Henzada a bird of the *kaing*-cultivation and partial to water, but out in the great Sittang paddy-plain in March and April, frequently seen in large flocks on burnt stubble, the immense number in the area only being realised when one sees the constant stream of birds coming to drink at the scattered tanks. I saw birds assuming spring plumage as early as February 10th and it occurs up to the fourth week in April on the stubble.

1215. **Alauda g. gulgula** INDIAN SKYLARK. ♂♂♀ 121, 122, 481, 482.

Noted as singing in December and a young bird just out of the nest was obtained on January 7th. Two breeding males with enlarged gonads were shot in the Sittang Plain on April 1st. These birds seem to prefer the wide expanses of 'dhoob' grass and the peafields to the stubble; I saw flocks in mid-August near Rangoon which were probably immigrants.

[These birds are a richer creamy brown below and darker above than most *gulgula* and have more buff on the tail. Winter birds from Pegu in the British Museum I cannot differentiate from *gulgula*.—C.B.T.]

1225. **Calandrella r. raytal** GANGES SAND LARK. 3 ♂ 2 ♀ 455-56, 584-85, 589.

Though Oates thought it did not occur South of Prome, I found it abundant right through the Prome and Henzada districts and down the Irrawaddy as far south as the Yandoon Island. So little of the island land survives at the height of the rains that it would be interesting to know if this bird performs a local migration then.

I have heard it singing in early December and saw many paired on December 26th but they apparently do not start breeding before mid-February.

[These are quite indistinguishable from birds from the Ganges. 3 males: wing 82 mm.; 2 females: wing 75 mm.—C.B.T.]

1253. **Zosterops siamensis** SIAMESE WHITE-EYE. 29.

I saw several large parties in the Zepathwe reserve near the sea in mid-February 1932 and did not observe it otherwise.

1257. **Chalcoparia singalensis** RUBY CHEEK.

I saw a single male near Henzada in July 1931.

1279. **Cinnyris asiatica intermedia** BURMESE PURPLE SUNBIRD. 3♂ ♀ 445, 513, 614, 656.

Several were obtained along the foot of the Henzada *yomas* from December to February.

1284. **Cinnyris f. flammaxillaris** YELLOW-BREASTED SUNBIRD. ♂ 486, 645.

Two obtained in Henzada at Ingabu and Legongyi.

[The difference in the amount of white in the tail, between this Sunbird and *asiatica,* in the females is not distinct, and in the absence of paired females of *flammaxillaris* I can give no certain distinctions for separating the two.—C.B.T.]

1345. **Picus canus hessei** BURMESE BLACK-NAPED GREEN WOODPECKER. ♀ 508.

I shot a female which was with a flock of Laughing Thrushes at Kywezin in the Henzada *yoma* on January 13th. (wing 155 mm.)

[Wing 155 mm. *Glydenstolpei* (Assam) ♂ wing 140-146 mm.; *hessei* (North Siam) ♂ wing 142-154 mm. This specimen in colour also is nearest to *hessei* but the two races intergrade.—C.B.T.]

1346-8. **Picus chlorolophus** SMALL YELLOW-NAPED WOODPECKER.

I saw individuals in the *yoma* foothills of Henzada and Insein but collected none.

1372. **Dryobates analis longipennis** SPOTTED-BREASTED PIED WOODPECKER. ♂ ♀ 533, 550.

Two were obtained on the northern border of the Henzada district in January 1931. They are small, shy and difficult to observe.

[Wing 97 mm. *D. analis* (Java) measure mostly ♂ 92-96 mm. and *longipennis* (Siam, Bangkok) mostly 98-102 mm. Burmese birds correspond fairly well with Siamese birds in being on the whole longer than Javan birds. The spotting on the breast seems variable in both races and good skins are needed to see any constant difference. Single birds from Burma (Thayetmyo) are no longer than Javanese birds (wing 92-94 mm.) while a female from Karenni measures 105 mm. I think *longipennis* should be recognised though it is not a very well defined race.—C.B.T.]

1379. **Dryobtes nanus canicapillus** BURMESE PIGMY WOODPECKER. ♂ ♀ 607, 608.

I shot a breeding pair in February 12th in *indaing* jungle near Kyibin (Henzada). This bird's small size, weak flight, and rudimentary crest made me think both were juveniles.

1389. **Micropternus brachyurus phaioceps** BURMESE RUFOUS WOODPECKER. ♂ 443.

I shot one of a pair seen at Inbin (Henzada) in teak trees in January 1931 (wing 127 mm.).

1399. **Dinopicus javanensis intermedia** GOLDEN-BACKED THREE-TOED WOODPECKER. 1 ♂ 2 ♀ 443, 633-39.

I obtained three at Inbin and Legon in the foothills of Henzada in January and February, which showed no signs of breeding.

[These types are practically topotypes.—C.B.T.]

1404. **Chrysocolaptes g. guttacristatus** TICKELL'S GOLDEN-BACKED WOODPECKER. ♀ 616.

Fairly common both in Insein and Henzada.

[Wing 162 mm.—C.B.T.]

1424. **Iynx torquilla japonica** JAPANESE WRYNECK. ♂ 448.

Occasionally seen in winter both in Henzada and Insein, in all sorts of places.

[Wing 87 mm. This and other Wrynecks from Burma in winter are on the whole more ochraceous on the underparts than European birds and in this respect they resemble *japonica*. The latter are, however, smaller and have the upper parts and wings darker and more rusty in colouration, whereas the Burmese birds are like *torquilla* on these parts.—C.B.T.]

1433. **Thereiceryx lineatus intermedius** BURMESE LINEATED BARBET. ♀ 641.

Common in both *yomas*, but a forest, and not a garden bird, as it is in Northern Burma; I saw a large gathering in Henzada on a *Ficus* tree in mid-February.

1436. **Cyanops a. asiatica** BLUE-THROATED BARBET. ♂ 643.

I shot one of a pair feeding on *Dillenia pulcherrima* seeds at Chondaung in the Henzada *yoma* foothills on February 16th, 1931, the only ones seen by me. Oates appears to have no records from the western part of Pegu or the delta, but this bird was exceedingly common in the Prome *yomas* on the Arakan side and probably extends down through Henzada.

1446. **Xantholaema haemacephala indica** Burmese Crimson-breasted Barbet. ♀ 487.

Common all over the area, and a bird of gardens, fields and open country.

1463. **Cacomantis merulinus querulus** Burmese Plaintive Cuckoo. 2 ♂ 2 ♀ 7, 35, 460, 546, 547.

Common throughout the area and (except in the breeding season, when I have seen it in dry scrub jungle, a bird of marshland and jheel sides. This bird is far from shy, and the only Cuckoo which gives one a good opportunity to watch it in the field.

[By a slip, two birds obtained by Mr. Stanford in Prome were listed under *Cacomantis sonneratii.*—*J.B.N.H.S.*, xxxv, p. 33.—C.B.T.]

1474. **Clamator coromandus** Red-winged Crested Cuckoo.

Several times seen in September, October and November, apparently on passage in Insein. I never observed it at any other time.

1475-76. **Eudynamis scolapaceus** subsp.? Koel.

Common, and widely distributed. The only young one seen by me was on May 4th, being fed by *Corvus insolens.*

1480. **Rhopodytes tristis** Large Green-billed Malkoha.

1491. **Centropus sinensis intermedius** Hume's Crow Pheasant.

1495. **Centropus b. benghalensis** Lesser Crow Pheasant.

These three birds all occur in the area, Hume's Crow Pheasant being common and the others rarely seen.

Psittaculidae.

The region of the foothills west of the railway in Henzada district was the only place where I had any opportunity to collect these birds, and it was curious that at each place, only one species was collected and the others were not seen at all.

1501. **Psittacula krameri borealis** Eastern Rose-ringed Paroquet.

I saw a few at various places in Henzada but it was not common.

1503. **Psittacula cyanocephala benghalensis** Blossom-headed Paroquet. 2 ♂ 1 ♀ 439, 440, 441.

Common at Inbin (Henzada) in late December 1930 and a pair seen courting.

1505. **Psittacula schisticeps finschi** Burmese Slaty-headed Paroquet. 2 ♂ 506, 509.

Great numbers in flocks near Kywezin (Henzada) in mid-January 1931, and probably the commonest Paroquet in Henzada. I watched some feeding on the seeds of *Dendrocalamus longispathus.*

1508. **Psittacula alexandri fasciata** Red-breasted Paroquet. 1 ♂ 2 ♀ 615, 636, 642.

Abundant down the *yoma* edge from Kyibin to Legon in mid-February 1931, in pairs and flocks and about to breed. Many were feeding on flowering *Bombax.*

1513. **Coryllis v. vernalis** Indian Loriquet.

Seen both in Insein and Henzada, but it is one of the small silent unobtrusive birds which is easy to overlook, and whose status is hard to determine. I have watched them feeding in a small tree on a village road, taking no notice of the people passing beneath.

1519. **Coracias benghalensis affinis** Burmese Roller.

For much of the year, this bird appears to be entirely solitary and one rarely sees more than one at a time. At certain seasons, considerable numbers can be seen together, e.g. on January 14th I watched a large gathering fighting together among teak trees where they probably intended to breed. Again on November 22nd I saw a large number on a grazing ground near Insein, the males displaying and chasing each other and taking long flights to and fro.

In the rains, only a few single individuals can be seen.

1524. **Merops orientalis birmanus** BURMESE GREEN BEE-EATER. 3 ♂ 1 ♀ 592, 593.

Common throughout the area, breeding from February onwards. I saw fledged young on May 2nd. In the sea coast area a large number breed in holes out on the flat open dunes above the normal tide-mark. I found Bee-eaters nesting in similar country in the Sunderbunds of the Khulna district, (Bengal).

A certain number remain throughout the rains but it is certainly not nearly so common.

1526. **Merops superciliosus javanicus** BLUE-TAILED BEE-EATER.

In Henzada and Insein this bird breeds all over the cultivated *kaing* land, in small holes in the pea-fields, in banks and the sides of earthen wells. On the sea coast on February 21st, I found a number of birds just commencing to breed on the open flat sand dunes behind the beach. (A party seen flying North on February 18th were probably on migration.)

Some undoubtedly winter on the Henzada jheels and the Hlawga lakes, but though it is then very local and easy to overlook, I believe the majority migrate, and migrants appeared in my garden on October 16th.

1528. **Melittophagus e. erythrocephalus** CHESTNUT-HEADED BEE-EATER.

I saw pairs in forest land in Henzada and Insein and a pair in the Zepathwe reserve on February 19th. It is a shy bird and easy to overlook. I think some undoubtedly winter on the Hlawga lakes but Armstrong thought it a migrant, appearing in February.

1529. **Bucia athertoni** BLUE-BEARDED BEE-EATER.

I saw a single bird at an elevation of about 800 ft. in the foothills near Kongyi (Henzada) in April 1931. It probably extends along the foothills of both *yomas* wherever there is evergreen forest.

1531. **Ceryle rudis leucomelanura** INDIAN PIED KINGFISHER. 475, 476.

Common, a bird of the jheels and the shallows of the larger rivers. Mr. Henricks obtained two young ones just out of the nest on January 7th in Henzada.

1533. **Alcedo atthis benghalensis** COMMON INDIAN KINGFISHER. 26.

Common and widely distributed down to the neighbourhood of the sea where a few occur in tidal waters in the Zepathwe reserve.

1540. **Alcedo meninting** subsp. BLUE-EARED KINGFISHER.

I am quite sure that I saw this Kingfisher near Kyachaung on the western side of the Pegu *yoma* in Insein district in October 1929. I did not obtain any, but the birds were common in dense bamboo jungle and their very brilliant colouring was most noticeable. At that time of year I expect they feed largely on insects.

1544. **Ceyx tridactylus** INDIAN THREE-TOED KINGFISHER.

I saw a single bird in April 1931 at a low altitude in the Henzada foothills and one was shown me as having been obtained in the grounds of the old Rangoon College near the 'Old Maidan'. It is a shy species, fond of bamboo jungle and easy to overlook.

1549. **Ramphalcyon capensis** STORK-BILLED KINGFISHER.

Fairly common and widely distributed. Occasionally occurs on the Rangoon Lakes.

1551. **Halcyon smyrnensis fusca** WHITE-BREASTED KINGFISHER.

Common all over the area, occurring even in the gardens of Rangoon, and far out on the tidal mud of the sea coast.

1554. **Halcyon pileata** BLACK-CAPPED KINGFISHER. 24, 25.

Apart from one seen by Mr. Henricks on February 10th, 1931, on the Kwingauk stream in the Henzada foothills, this bird is confined to tidal water and was rightly considered by Armstrong to be the most 'markedly characteristic' bird of the Rangoon river coast line. Here it is extremely abundant, not only alongshore, where it feeds on crabs, but inland as well in the willow and mangrove jungle, where it is not at all shy. It occurs up to Rangoon and Insein along the tidal creeks, and I once saw one on the Rangoon Lakes. In the tidal area, I saw no banks suitable for nesting holes and possibly it breeds in ants' nests.

1557. **Sauropatis ch. chloris** White-collared Kingfisher. ♂ 58.
Armstrong obtained four in the Rangoon River delta and considered it rare. I saw four or five in the forest area west of the Rangoon river, in *Sonneratia* jungle along tidal streams, and once in very dry open scrub jungle with an undergrowth of what Burmans call 'sea-sessamum', where a pair were apparently insect-hunting. The flight is curiously hesitant and weak and they look more like a Cuckoo-Shrike than a Kingfisher in flight. One out of a pair uttered a cry like a Wryneck. They were not at all shy and are probably confined to forest country in tidal limits.

1566. **Anthracoceros malabaricus** Burmese Pied Hornbill.
Harington records both this and *Dichoceros bicornis* from Taukkyan, whence the heavy jungle has long since disappeared. I have seen *Anthracoceros* in both the Henzada and Pegu *yomas*.

1583. **Upupa epops longirostris** Burmese Hoopoe. ♂ 638.
I think this bird probably performs a local migration to the foothills and more wooded parts of the country to breed. In 1929 the first birds noticed were on October 10th and from then on it is common till February. I saw birds paired and about to breed in the Henzada foothills in mid-February and in the same year saw young just able to fly, near Kalaw (S.S.S.) in early August.

1586. **Harpactes e. erythrocephalus** Red-headed Trogon. ♂ 646.
Occurs in some numbers in the foothills in both *yomas*.

1593. **Micropus p. pacificus** Large White-rumped Swift. ♀ 609.
I shot two out of a large flock hawking over *indaing* jungle near Kyibin (Henzada) on February 12th, 1931, the only ones seen for certain.

[This specimen belongs to the typical race; *cooki* from the Shan States has much coarser streaks on the throat and rump. As regards the general colouration of the upper parts, season evidently makes a good deal of difference, for *pacificus* from Siberia in May is more different from *pacificus* from Australia in winter than the latter is to *cooki* in May.—C.B.T.]

1599. **Micropus affinis subfurcatus** Malay House Swift.
Breeds in the High Court and Secretariat at Rangoon from June up to early October. I have seen parties in Rangoon in mid-December but the bird is usually not noticeable except in the rains. It is noteworthy that Oates found a pair of Swifts nesting at Wanetkon on the Rangoon-Pegu Road in January.

1602. **Tachornis batassiensis infumatus** Eastern Palm-swift.
Occurs throughout the area, breeding in toddy and cocoanut palms where they occur. I have not noticed it breeding in the roofs of thatched huts as it does in Northern Burma.

1616. **Hemiprocne coronata** Indian Crested-swift.
A very local bird. Nearly all I have seen have been in places where girdled, or dead, teak-trees occur in fairly open country. This type of country is common in the northern part of Henzada and in places in Insein.

1629. **Caprimulgus monticalus** Franklin's Nightjar. ♂ 606.
I shot one and saw others on February 11th, 1931, in the Henzada *yoma* foothills. The male shot uttered a curious loud single note unlike a nightjar. It is noteworthy that all the occurrences noted by Oates are from Eastern Burma, roughly Toungoo to the Thaungyin valley and that neither Harington, Mackenzie or Wickham apparently met with this Nightjar.

1630. **Caprimulgus asiaticus** Common Indian Nightjar. ♀♀ 657, 658.
On the flood embankments of Insein, numbers could be seen sitting after dark, their eyes gleaming redly from a distance in the lights of a motor. Those obtained were accidentally killed by me in this way and in Insein I once killed three with my car during an early morning drive. These birds spend the day in the bushes near the embankments and have probably left to breed in March, as far as I have observed.

1631. **Lyncornis cerviniceps** Great-eared Nightjar.
I saw a gathering at Kyachaung in the Insein *yomas* on October 22nd, 1929; at dusk they were seen flying high over the forest and then six or seven

gathered to hawk flying-ants, circling close to a tree-top and uttering a low deep croak. Their size and stately flight distinguished them from the other Nightjars round the tree. The ears of one shot remained fully erect for some time after death, and its throat was full of wingless white ants, many still alive.

1636. **Tyto alba** The Barn Owl.

1636A. **Tyto alba** The Barn Owl.

I have seen a few in Hanthawaddy and around Rangoon. Harington describes it as common in Rangoon—I have not collected any.

[Dr. Hartert has shown that the Indian Barn Owl is not the same as the Javanese bird (Novit. Zool., xxxv, p. 98, 1929). He has named the Indian bird (type locality, Cachar) *stertens*. I have not gone into the question to which race Burmese birds belong.—C.B.T.]

1643. **Asio f. flammeus** Short-eared Owl. 421.

I shot one on a sandy island on the Irrawaddy in Henzada on December 24th, 1930, which did not seem to mind the glare of afternoon sunlight on the sand at all. On February 3rd, 1931, I flushed another while walking pea-fields for quail near Yele, and in February 1932, two more out of paddy stubble close to the sea at Kamakalok in the Hanthawaddy district. All these birds had chosen remarkably shadeless places to lie in by day, and those at Kamakalok had undoubtedly been attracted by a plague of rats.

[No paler than some British examples of the same date.—C.B.T.]

1685. **Athene brama pulchra** Burmese Spotted-owlet.

This bird is certainly common in Henzada, but Harington observes (p. 55) that in Rangoon their place is taken by *Glaucidium cuculoides*.

1690. **Glaucidium cuculoides rufescens** Burmese Barred-owlet. 211.

The only one seen for certain was obtained on the eastern side of the Pegu *yomas* at Aukkanyinmyaung in May 1923. Harington noted it as breeding in February near Rangoon.

1704. **Pandion h. haliaëtus** Osprey.

I have seen this bird on Hlawga Lake in Insein and at various places in Lower Burma along the larger rivers up to the end of March.

Harington thought it might breed in Burma and, if it does anywhere, the lonely forest fringing the creeks near China Bakir seems admirably suited to this species.

1706. **Sarcogyps calvus** Black Vulture.

Seen in small numbers all over the area. A pair were repairing a nest in Rangoon in early October and I found another pair in February nesting in the old Pilakat reserve. At the nest they are remarkably tame, even if a gun is fired near them.

One seen at close quarters in November 1931 had a noticeable white patch at the base of the neck.

1713. **Pseudogyps bengalensis** Indian White-backed Vulture.

Common. It breeds in cocoanut palms in Rangoon where I saw several incubating on November 9th and I saw others breeding in forest trees in the Mingalun reserve (Hanthawaddy).

The nests are usually made of dead leaves and branches with the leaves adhering.

1718. **Falco peregrinus calidus** Eastern Peregrine Falcon.

It is fairly common all over the area from December to mid-April and is most frequently seen at dusk, when it often takes the same route night after night. Individuals were seen far out on the muds below the tide line.

A Peregrine haunted the roof of the Secretariat in November 1931, and used to puzzle me by lying flat on its belly on a narrow ledge with its wings spread out and its head towards the wall of the building. In this attitude it would remain for ten minutes or more at a time as if rubbing its feathers on the stone. I watched it on numerous occasions with glasses at close quarters, and could never make out what it was doing.

1719. **Falco peregrinus peregrinator** Shahin.

I saw one in the old mule-grazing ground at Yegu in October 1929, and had a good view of its rich rufous breast. This, and its large size, made it a most conspicuous bird.

1724-28. **Falco subbuteo?** HOBBY.
I have twice seen Hobbies in Henzada district at fairly close quarters but never managed to obtain them.

1741-42. **Cerchneis tinnunculus** KESTREL.
Fairly common from November to March throughout the area. Saw no signs of any breeding.

1745. **Cerchneis naumanni pekingensis** CHINESE LESSER KESTREL.
As already recorded (*Journal*, November 15th, 1932) I shot two males out of a large gathering which were presumably on migration at Lunbye in the Sittang Plain on April 1st, 1932. This is the first record for Burma.

1765-66-67. **Haematornis cheela** CRESTED SERPENT-EAGLE.
I had a close view of one in high forest on the Insein *yoma* in October 1929, but failed to obtain this, or others, seen later on.

1775. **Butastur liventer** RUFOUS-WINGED BUZZARD EAGLE.
I saw a party of five or six on January 23rd at Pauktaing in Henzada which from their actions seemed to be pairing. These birds are partial to teak forest on the border of cultivation and though apparently rather sluggish birds, they are extremely wary and difficult to get a shot at.

1778. **Haliaëtus leucogaster** WHITE-BELLIED SEA EAGLE.
Armstrong, who obtained one near China Bakir, describes it as 'found sparingly along the coast and very shy'. He also obtained *Icthyophaga ichthyaëtus* on the Rangoon river. I saw at least two species of pale-headed eagles on the creeks near China Bakir but failed to obtain any, or get a satisfactory view of them on the ground. The distribution in Burma of these two species and *Haliaëtus leucoryphus*, which are all stated to occur in Burma, urgently needs careful working out.

1784. **Haliastur indus** BRAHMINY KITE. ♂ 177.
Breeds all over the area, and in the south of the Sittang-Rangoon river plain sometimes very low down on account of the paucity of trees. I found both eggs and young birds in early February in Hanthawaddy. Only a small number appear to stay throughout the rains but possibly they move to the big jheels which are rarely visited at this time of year.

1787. **Milvus migrans govinda** COMMON PARIAH KITE.

1788. **Milvus migrans lineatus** BLACK-EARED KITE.
Immense numbers of these Kites appear in mid-September and early October, one of their principal strongholds being the woodlands round the Royal Lakes in Rangoon. Though I have never shot any, I have been able clearly to distinguish the slim, smaller chocolate-brown Kite which breeds, from the larger, darker Kite with a blackish back and yellow-white patches under the wing, which can be seen resting on waste ground throughout the day and which Harington says is the more numerous. *Govinda* undoubtedly breeds on the Secretariat in Rangoon, and all over the plain in small numbers down to the sea. I saw a pair of which the female was sitting on November 2nd, 1931, at Yegu, and another bird carrying sticks on November 4th. In the Sittang Plain, some of the nests are in very low and conspicuous positions owing to the shortage of trees.

The evening flight of Kites over the Royal Lakes is one of the features of Rangoon, and a large troop of them hawking flying-ants, when the latter are swarming, is a wonderful sight. The ants are frequently taken in the talons and transferred to the mouth. I watched one on November 5th, 1931, being attacked by a Peregrine just over the roof of the Secretariat, and as the Falcon stooped on its tail and dropped its claws, the Kite turned gracefully upside-down in the air and struck upwards at the Falcon with its claws—a manoeuvre requiring marvellous timing. *Lineatus* in the Sittang Plain is a village-haunting bird feeding largely on offal, and gathering in large numbers to roost in the few clumps of trees in the area.

1789. **Elanus caeruleus** BLACK-WINGED KITE. ♂ 529.
Not uncommon all over the area, and like the Kestrel, which in its habits

it much resembles, a bird of the plains. I have seen as many as five or six together towards nightfall, when all *Raptores* congregate. I feel certain it breeds in Henzada as I saw two pairing in April, and individuals as late as mid-June, but have never found a nest.

1790. **Circus macrourus** PALE HARRIER.
I twice saw a single adult bird in 1931 crossing the Eikpyet jheel in Henzada, but very pale immature birds which I shot in the Sittang Plain turned out to be *melanoleucus*. I saw one adult near the Eastern Grove lighthouse in February. Oates seemed to consider this bird was common but I am inclined to doubt if it is at the present day.

1793. **Circus melanoleucus** PIED HARRIER. 2 ♂ 2 ♀ 71, 127, 130, 136.
Common all over the area from November to early April, both on marsh and stubble, and often allows a very near approach. I have watched a great many hunting, and small birds seem to take so little notice of them that their food must be principally mice, beetles, etc.

1794. **Circus æ. æruginosus** MARSH HARRIER. 3 ♂ 123, 126, 566.
Common all over the area, mainly on jheels but in the Sittang Plain in the wide grassy depressions which are jheels only in the rains, from November to mid-April.

1805. **Astur badius poliopsis** HUME'S SHIKRA.
Not uncommon and seems partial to bamboo jungle. In January one was frequently 'mewing' in my garden in Henzada and, on one occasion, when mobbed by *Corvus insolens* took refuge on the ground under a bamboo clump.

1811. **Accipiter nisus** SPARROW-HAWK.
Several times seen in Henzada in the foothills but I failed to obtain any.

1918. **Pernis ptilorhynchus** subsp. CRESTED HONEY-BUZZARD.
Seems to breed along the foot of the Henzada *yomas* and its curious note can be heard a long way off. I saw one which had a nest at Chondaung in Henzada in February 1931 and was told a pair nested there annually.

1827. **Crocopus phoenicopterus viridifrons** BURMESE GREEN PIGEON. ♂ 655, 216.
Common in Henzada but I shot very few Green Pigeons elsewhere. A male shot on February 17th was about to breed.
I noticed some feeding on the berries of the '*zi*' thorn. They were still in flocks on the eastern side of the Pegu *yomas* on May 10th.

1830. **Dendrophassa pompadora phayrei** ASHY-HEADED GREEN PIGEON. ♂ 628.
Not uncommon in the Lemyethna foothills (Henzada) in February; a male shot on February 13th was about to breed. Harington recorded it from Rangoon.

1836. **Dendrophassa bicincta** ORANGE-BREASTED GREEN PIGEON. ♂ 54.
One was shot out of a pair in the Zepathwe reserve on February 19th.

1846. **Muscadivora aenea** GREEN IMPERIAL PIGEON.
Seen in small numbers along the foothills in Henzada and Insein.

1852. **Chalcophaps indica** EMERALD DOVE.
Seen in small numbers in both Insein and Henzada and breeds in the cane-brake portions of the scrub jungle close to Rangoon.

1870-72. **Streptopelia orientalis** subsp. RUFOUS TURTLE DOVE.
In Lower Burma this is much more a jungle bird than *chinensis* or *oenopopelia*, and is rarely seen away from it. Occurs in some numbers in the Henzada and Insein foothills, and appeared to be breeding in the latter in late October.

1874-75. **Streptopelia chinensis tigrina** BURMESE SPOTTED DOVE.
Common and comes into the gardens round Rangoon to breed at the end of the rains.

1881. **Oenopopelia tranquebarica humilis** BURMESE RED TURTLE DOVE.
Very common in flocks from November to March. I saw pairs which were undoubtedly breeding in April in the sparse jungle on the north of the

Yandoon Island (Maübin), but have not seen them elsewhere in the area during the breeding season.

1897. **Pavo muticus** Burmese Peafowl.

It is said to be very plentiful in parts of the Henzada *yomas*. Mr. C. W. Scott, I.F.S., who has an extensive acquaintance with the Insein *yoma* reserves, states that peafowl are very rare in Insein, but that an occasional bird is reported as far south as Taikkyi.

Mr. E. O. Bloech confirms this and saw some still further south a few years ago.

1904. **Gallus bankiva robinsoni** Burmese Jungle Fowl.

Very common in suitable places in all districts where it is not persecuted. I have seen some near the sea in the Zepathwe reserve and it still survives in the scrub-jungle, which has replaced the old forest between Mingaladon and Rangoon.

A hen, shot in a beat in January 1933, had a number of small firm tumours on the neck, legs and wings varying in size from a millet seed to a hazel nut. There was a group of seven or eight on the anterior margin of the wing, which prevented the bird flying.

I have seen eggs in late January. Many jungle-fowl live on the densely-wooded islands of the Hlawga Lake, apparently throughout the year. These birds are a long way from any source of grain supply, and I have seen wounded ones, dropped on the water, swim strongly to land.

1923. **Gennaeus lineatus** subsp. Silver Pheasant. 1, 2.

I failed to obtain any, except a pair shot near the seventeenth mile on the Rangoon-Prome Road by Mr. Mather which are now in the British Museum. The Insein Forest Division Working Plans Report states that they are very common in the Mahuya reserve.

1948. **Excalfactoria c. chinensis** Blue-breasted Quail.

I have shot this in stubble in Henzada and seen it on the Kya-in swamp in Insein. It certainly breeds in some numbers during the rains in the long grass, both on the polo-ground in Rangoon and on the new race-course at Kyaikkasan where I flushed numbers in August.

1952. **Coturnix coromandelica** Black-breasted Quail. ♂ 578.

I shot a male of this species on the Irrawaddy pea-fields in South Henzada on February 3rd, 1931, with enlarged gonads and it was, I should say, breeding there in some numbers. All this land is under water by mid-June, so they presumably migrate locally before then.

1981. **Francolinus pintadeanus phayrei** Phayre's Burmese Francolin. ♂ 532.

Oates considered that this bird was not found below Prome. It is possible that it has extended southwards with the spread of cultivation and the rapid reclamation of swamp and forest due to the growth of population, embankments, etc. I have one or two records from the Insein district about 30 miles north of Rangoon, and it is certainly not uncommon in the Henzada district along the *yoma* edge within ten miles of the southern boundary of the district. I also heard Francolins calling in the Irrawaddy pea-fields below Henzada town. In some places I have heard ten or twelve birds calling simultaneously before dusk but have been unable to prove if they actually congregate to roost. It is a bird far more often heard than seen. As an instance of this bird's skulking powers, Mr. Gallant, I.F.S., and myself spent a fruitless evening looking and listening for Francolins near Legongyi, and at dawn next morning one was calling loudly from some bushes, where presumably it had been roosting, within 15 yards of our camp. Nothing we could do with beaters, etc., succeeded in dislodging this bird.

2008. **Turnix suscitator pallescens** Pegu Bustard-Quail. ♀ 635.

I shot a female which was not breeding at Legon (Henzada) on February 14th and Mr. Villar obtained one in the Kyangin reserve in March.

[These Turnix seem very variable and the series in the British Museum is none too good. *Pallescens* is possibly recognisable on the average of a series but it is not at all a distinct race.—C.B.T.]

2008. **Hypotaenidia striata** INDIAN BLUE-BREASTED BANDED RAIL.

I saw several in the Insein district and have reason to believe it breeds on the Rangoon race-course at Kyaikkasan. I believe it to be a rains immigrant, as it is never seen at other times.

2022. **Amaurornis phoenicurus chinensis** CHINESE WHITE-BREASTED WATER-HEN.

Common. In mid-May 1931 a pair bred in my garden in Henzada, the nest being 25 feet from the ground in a bamboo clump, a long way from water. The birds fed on my lawn morning and evening, apparently on insects. They were silent all day but occasionally indulged in their customary outbursts about dusk. There were one or two other nests in similar situations, and for a month or so, remarkably far from water.

2026. **Gallinula chloropus indicus** INDIAN MOORHEN.

Occurs in Henzada in small numbers.

2027. **Gallicrex cinerea** THE WATERCOCK.

I saw individuals in Henzada in flooded paddy land in the rains, where they were presumably breeding. This is rather a mysterious bird whose status is most difficult to define, and like the Chestnut Bittern, it is usually only visible in the rains.

2028. **Porphyrio p. poliocephalus** INDIAN PURPLE MOORHEN.

Common on suitable large swamps. I found these Moorhens flighting in large numbers at dusk to the rice-fields near the Kya-in swamp, where they were said to do a great deal of damage with their heavy feet.

2031. **Metopidius indicus** BRONZE-WINGED JACANA.

2032. **Hydrophasianus chirurgus** PHEASANT-TAILED JACANA.

Both these Jacanas occur all over the area, and on the jheels where they breed, the majority seem to leave after the breeding season.

2033. **Rostratula b. benghalensis** PAINTED SNIPE.

Probably resident, but little seen. In April 1931 I flushed a number feeding in dry grass a considerable distance from water.

2047. **Burhinus oedicnemus indicus** INDIAN STONE PLOVER.

The only ones observed were a breeding pair whose eggs I found on March 15th on a sandbank below Henzada. They were remarkably tame and completely silent and allowed a very near approach.

The eggs were sheltered from the afternoon sun by a tuft of grass growing on the sand.

I have never heard in Burma the wild and musical outcries so characteristic of this bird in its European breeding haunts.

2049. **Esacus recurvirostris** GREAT STONE PLOVER.

Not seen except for three birds seen on December 24th on a sandy island above Henzada, but I had little chance to explore some of the larger islands.

2055. **Glareola maldivarum** LARGE INDIAN PRATINCOLE.

Perhaps the most distinctive breeding bird of the great plains of the delta, both in Pegu, Henzada, Maübin, Pyapon and Hanthawaddy. These great expanses of burnt stubble in March and April exactly suit it as a breeding haunt, and though there are no large colonies, scattered pairs occur all over the area. Some nest on short grass, e.g at Eikpyet near Henzada, and I have seen a fair-sized colony on the Kyungale grazing ground, but the majority prefer the open stubble. In the late afternoon individuals can be seen hawking miles from their breeding grounds. It certainly remains in its nesting haunts till mid-June and Oates thought a few remained up to mid-August. I saw a small flock near Pazundaung on November 1st, 1931, so possibly some are resident throughout the year.

2056. **Glareola lactea** SMALL INDIAN PRATINCOLE.

Breeds in Henzada and Maübin on the Irrawaddy islands. A few probably stay throughout the rains and it becomes common again from November onwards.

2060. **Larus ichthyaëtus** GREAT BLACK-HEADED GULL. ♀ 57.

Armstrong did not meet with this Gull, which Oates mentions as abundant in the Sittang canal. I saw several on the sands at Wetkaik (Hanthawaddy) on February 20th, two at least of which appeared to be in full summer dress. I did not see any at Kamakalok during a few days' stay in April. This bird has the orbital skin crimson, a character noted by Hume but not in the *Fauna*. Its great size and black head and neck are distinctive field characters.

2062. **Larus brunneicephalus** Brown-headed Gull. ♂♂ 48, 59.
Winters in large numbers on the Rangoon river as far as Rangoon but does not seem to come up higher, except on migration. I saw several parties at Yandoon (Maübin district) on April 27th which were apparently migrants and saw a large flock of Black-headed Godwits at the same time.

I kept a look-out for *ridibundus* and though many immature birds seen following steamers look to me indistinguishable from European examples of *ridibundus*, I never saw a full-plumaged bird. This iris of immature *brunneicephalus* is olive-green but when mature the pale iris contrasts with the ash-brown head.

2068. **Chlidonias leucopareia indica** Whiskered Tern. 21, 70, 165-66, 170, 172.
I saw parties in Insein apparently migrating across country on October 5th and 15th, and a very large gathering on the Ingyi lake in Lemyethna (Henzada) on February 18th. On April 26th, a large number appeared below Henzada, hawking insects over the pea-fields.

2072. **Gelochelidon n. nilotica** Gull-billed Tern. 15, 62, 141-42, 161, 199.
It is curious that Oates never met this bird on the Sittang or elsewhere, as in January and February it was one of the most conspicuous birds of the vast paddy plain, to a distance of ten miles or so from the sea. Large numbers could be seen daily hawking over the stubble, and the pools and depressions left after the rains. Like the Whiskered Tern, I suspect this Tern feeds to a considerable extent on insects. I saw very large numbers in April and May all along the sea coast (Armstrong also noted its abundance in 1875-76), but those shot did not appear to be breeding and a bird in immature plumage was shot on May 5th. I found no suitable place for a breeding colony and all local Burmans, of whom I enquired, were positive that there was no place between the Sittang mouth and the Rangoon river mouth which was not covered by the spring tides. At the same time, the bird is so common that it almost certainly breeds somewhere on this coast or in the Andamans. I did not see this bird in Henzada, Maübin or elsewhere in the area.

2080. **Sterna aurantia** Indian River Tern. ♀ 570.
Breeds on the islands in Henzada and Maübin in some numbers. The local name for all Terns is '*zin-yaw*'. It occurs in Henzada from November to June but I am unable to say if some stay throughout the year. At dusk these Terns nearly always flight up or down the river, probably catching insects.

2081. **Sterna melanogaster** Black-bellied Tern. ♂♀ 583, 597.
This is the only freshwater Tern which habitually leaves the main rivers, and hawks over wayside ditches and ponds. Nests along the river in Henzada and Maübin, and one of a pair shot on February 8th had a large soft egg in the ovary. I saw a very big flight going north up the river on December 25th and some appeared to have paired already in this month.

2088. **Sterna albifrons sinensis** White-shafted Ternlet. 44, 45.
I shot individuals alongshore in February and saw a few single birds in April but saw no signs of breeding colonies alongshore. The only breeding colonies found were one in Maübin on an island in the Irrawaddy above Yandoon, and several in Henzada. I saw one nest with eggs on April 27th. I noted individuals in Henzada up to July.

2100. **Rhynchops albicollis** Indian Skimmer.
Breeds in small numbers both in Henzada and North Maübin on suitable islands along the river. It is a bird which, being so conspicuous, prefers to nest far out in the middle of a vast stretch of open sand, from which it can see an intruder a long way off.

2101. **Strepsilas i. interpres** TURNSTONE. ♂ 156.
Armstrong did not meet with this bird, and I can only find one Burma record of a September migrant shot by Oates. I obtained a male—which may have been a newly-arrived immigrant—at Kamakalok, on April 16th, 1932. It was feeding busily in the middle of the afternoon, among a flock of sleeping *Cirrepidesmus* on grass-covered mud.

2102-03. **Squatarola squatarola** GREY PLOVER. 19.
Not met with by Oates, but by no means uncommon along the shoreline from Kyaikto to Elephant Point. Armstrong noted its shyness, and it is certainly less approachable than the Golden Plover and keeps to the tide mark especially where rocks occur. I did not shoot any in breeding dress to ascertain the race.

2106-07-08. **Leucopolius a. alexandrinus** KENTISH PLOVER. 16, 154, 594.
Armstrong noted that it was quite as abundant as *Cirrepidesmus* and I found it common on the mud flats and nearly always in their company all along the coast. Small parties haunt the Rangoon race-course at high tide, where they are very fond of the worn circles round which ponies are led, and I have twice seen parties in breeding dress—apparently on migration—on the Irrawaddy in late April. Pairs were seen mating on February 5th.

2110-11. **Haematopus ostralegus** OYSTER-CATCHER.
Neither Oates, Armstrong nor myself met this conspicuous bird for which I kept a careful look-out. Mr. S. F. Hopwood told me he had seen it some years ago on the beach at Letkokkon near China Bakir.

2113. **Charadrius dubius** LITTLE RINGED PLOVER. ♂ ♀ 185, 436, 466.
Among the many thousand waders seen by me daily on the sea-coast mud, I failed to detect a single Ringed Plover of any species. There is no doubt that in its winter haunts, this bird, and *not Cirrepidesmus*, is the real Sand Plover. A few *Ch. dubius* were to be seen on the sandy beaches (relics of former tide-marks) which occur in the paddy-fields, and they were frequently to be seen on threshing floors far out on the stubble, as also on the laterite ridge near Rangoon where the hard short grass seems to suit them. On the tidal mud, where the bulk of the waders congregate, they were not to be seen.

2117. **Cirrepidesmus mongolus atrifrons** LESSER SAND PLOVER. 20, 31, 195, 196, 204.
This bird is locally known to the Karens in Thaton as *dilon-gaung*, an allusion apparently to the brick-red colour of the crown and upper breast in breeding plumage. The *Fauna* accidentally omits any mention of its occurrence in Burma, but it occurs in immense numbers on the tidal mud of the coast line, and in small numbers up the tidal creeks.

It must pass up the Irrawaddy on migration, but no one seems to have recorded it.

2118. **Cirrepidesmus leschenaulti** LARGE SAND PLOVER. 64, 140.
Does not seem to occur in quite such numbers as *atrifrons,* but I saw a good many on the tide line and in April and May, when they look foxy-red with a black line through the eyes and on the forehead, they are remarkably beautiful birds.

The *Fauna* states that *leschenaulti* has a white forehead, but one seen in a good light seemed to have a completely black forehead and another obtained had black on the centre of the forehead.

2120. **Charadrius dominicus fulvus** EASTERN GOLDEN PLOVER.
Arrives with the first snipe about mid-August and is present in breeding plumage in the first week in May. It does not haunt the actual mud of the coast line, but is found on the grass above the tide line, on stubble and grazing-grounds, and also on the short grass covering the laterite ridges near Mingaladon. Numbers are caught by the Hlegu bird-catchers.

A bird shot on April 14th had a wing of 174 mm. (the *Fauna* gives 160-165).

2124. **Hoplopterus ventralis** SPUR-WINGED PLOVER. ♀ 595.
Common in the higher sandy reaches of the delta rivers, and on the hill streams, but not found within tidal limits. In Henzada and Insein it presumably performs a local migration when the river rises.

2127. **Lobivanellus indicus atronuchalis** Burmese Redwattled Lapwing.
Common in Henzada and Insein and a bird of the paddy fields. I have not seen it on shingle and sand-banks, nor within tidal limits.

2129. **Microsarcops cinereus** Grey-headed Lapwing.
Occurs from October to April on the edges of all the big jheels and is very common in the Sittang Plain on the big grassy depressions which in the rains are uncultivated swamps. The *Fauna* states that in Assam it is never found in flocks but I have seen quite large flocks in various parts of Burma.

2134. **Numenius arquata lineatus** Eastern Curlew. ♂ 160.
Very common on the tidal mud all along the coast, and seen up to May 10th. Armstrong remarks that they were always 'excessively shy', but I found them at first easy to drive by hiding in creeks or behind old stumps on the tide line. They are occasionally seen flying over Rangoon.

2135-36. **Numenius phaeopus** subsp. Whimbrel.
Armstrong noted its abundance on the tide line, but thought it was not so common as the Curlew. In April 1932 my impression was that Whimbrel were the more numerous. In this area, both Curlew and Whimbrel follow the narrow winding creeks when feeding, far up into the interior, and I have frequently flushed them from under bushes almost at my feet, or in mangrove jungle, and once in high forest in the Pilakat reserve where one might expect to see a Jungle Fowl or a Pheasant, and certainly not such a shy and wary bird as *Numenius*.

2138. **Limosa l. melanuroides** Black-tailed Godwit. ♂♂♂♀ 138, 139, 192, 193.
I saw two or three large flocks on the tide line on April 13th and 14th, and a flock of forty on passage near Yandoon on April 27th on the Irrawaddy. Only two of this last flock showed any signs of assuming summer plumage, apart from rusty streaks on the throat. There was great individual variation in measurements and those of five measured by me, before skinning were: wing 188.5-204 mm.; culmen 75-97 mm.; tarsus 65-72 mm.

All these Godwits—and I examined a number which were shot and not preserved—had a conspicuous white patch immediately below the eye and a white supercilium, and the basal portion of the bill was deep mauve-pink (not as described in the *Fauna*).

2141-42. **Terekia cinerea** Terek Sandpiper. 43, 144.
Oates considered it common, but I never saw it far away from the tidal line of the sea and Armstrong described it as by no means abundant and only obtained two or three. I saw a good many at Kamakalok in February and mid-April, nearly all on the grass-covered mud above the normal tide line. Two obtained in April had bills of 47 and 52 mm. and were apparently of the western race.

2143. **Tringa ochropus** Green Sandpiper.
Occurs from August to April all over the area and is never seen except singly or in pairs.

2144. **Tringa stagnatilis** Marsh Sandpiper. ♂♀ 39, 525, 561.
Observed on jheels in Henzada and Insein, and individuals were seen near the coast with Redshanks and Spotted Shanks, both at small pools on the saltings. Its trivial name in Oates' day was the 'Little Greenshank' which well describes it, the sharp double note 'Kewip' being also distinctive.

2145. **Tringa hypoleucos** Common Sandpiper.
Armstrong describes it as 'usually in small parties in cultivated lands and ploughed fields'. The Common Sandpiper in Burma is always, in my experience, a solitary bird, though one occasionally sees two together, and the description better suits the Wood Sandpiper or Temminck's Stint. The bird haunts the tidal creeks, even in dense mangrove jungle, but is not a bird of the mud flats. It is common on every river in Lower Burma.

2146. **Tringa glareola** Wood Sandpiper. ♀ 530.
Very common from August to April and occurs in immense numbers at the same time as the first Pintail Snipe come in. Later it is spread over

every jheel and along every river, but is a bird of fresh-water and does not occur on the tidal mud.

2148. **Tringa totanus terrignotae** CENTRAL ASIAN REDSHANK. 14, 36, 37, 150-52, 152a, 163.

Very common in flocks at Kamakalok and also on the Kyaikto estuary from February to early May. All those shot in April were identified as *terrignotae,* and were very heavily spotted on the throat, breast and sides, and showed traces of cinnamon brown on the crown and back. In February some of these birds had a noticeably pale supercilium (specimens measured fresh were as follows: wing 155-170 mm.; culmen 42-47 mm.; tarsus 47-52.5 mm.).

2149. **Tringa erythropus** DUSKY REDSHANK

A few were seen with *terrignotae* at Kamakalok in February.

2150. **Glottis nebularia** GREENSHANK. ♀ 490.

Abundant in every part of the five districts, both on jheels, rivers and the tide line, and in February and March sometimes assembles in large parties.

I kept a close look-out for Armstrong's Sandpiper (*Glottis guttifer*) which was shot out of Sand Plovers near China Bakir in December 1875, but until someone describes the field characteristics of this bird, it will probably go unrecorded.

2155. **Erolia m. minuta** LITTLE STINT. ♀ 202.

2156. **Erolia m. ruficollis** EASTERN LITTLE STINT. ♂ 145, 146, 153, (winter) ♂ 526.

Common along the Sittang-Rangoon River coast line, its favourite haunts being the grass-covered mud just above the normal tide limit. Many undoubted *ruficollis* were seen at Kamakalok in April, the rufous cheeks and throat being most noticeable. I obtained a single *minuta* on Kyaikto estuary (Thaton) on May 6th, in spring dress with dark-brown ear coverts and no trace of rufous on cheeks or throat.

I obtained one in Henzada but the bulk of the Stints seen there were *temminckii.*

2157. **Erolia subminuta** LONG-TOED STINT. 60, 61, 147, 155, 157, 164, 166, 168.

Oates described this bird as abundant all over Pegu and it is curious that Armstrong did not apparently meet with it. I shot one when snipe shooting inland in Insein, but failed to detect it in Henzada.

It was common on the coast line, and in April and early May could be easily distinguished by its remarkably dark, almost black, crown and upper parts, contrasting strongly with the pale rufous, or whitish grey of *E. minuta.* One shot on February 20th had the first primary on both sides in sheath and about an inch long.

2158. **Erolia temminckii** TEMMINCK'S STINT. ♂ 432, 180-81, 189, 190, 213-14.

Away from the coast line, where Armstrong did not meet it, and I saw very few indeed, in February, this Stint is the commonest Stint in Lower Burma. I have seen considerable flocks on the Eikpyet jheel in Henzada in December and at various places when snipe shooting, in August and September. In April, I failed to detect a single one among the thousands of waders on the coast but shot numerous specimens along streams inland in the Pegu district and on the sandy islands of the Irrawaddy near Yandoon.

The late F. M. Ogilvie had a theory that *E. minuta* and *temminckii* had quite different food and feeding grounds, and in Burma, except when on passage, *temminckii* seems to haunt much the same terrain as the Common Sandpiper, being partial to sand and fresh water, and not a bird of the tidal mud.

2160. **Erolia testacea** CURLEW SANDPIPER. 34, 148, 158, 165.

Common alongshore, and in mid-April, many were seen in breeding plumage, others not having yet changed at all. It is certainly not spread over the whole of Burma as the *Fauna* suggests, and Armstrong described it as 'by no means common' at the mouth of the Rangoon river.

2161a. **Calidris c. canutus** KNOT. ♂ 143.

Armstrong obtained a specimen near China Bakir, apparently *tenuirostris,* and describes it as 'rare'. I shot an example of *canutus* just assuming its spring dress, out of a flock of Curlew Sandpipers and Sand Plovers at Kamakalok on April 14th, 1932 (culmen 31 mm.; tarsus 30 mm.; wing 160 mm.). There are only two previous Indian records, and I saw no other Knots among the many thousand waders on this coast.

2164. **Limicola faclinella sibirica** Eastern Broad-billed Sandpiper. 40, 149, 149a, 203.

Armstrong described it as 'excessively common along the coast and up the Rangoon river as far as the Pegu river mouth'. It is curious that Oates only obtained one. I found it common from Kyaikto to the China Bakir, in the company of Stints, *Cirrepidesmus* and Kentish Plovers, up to the first week in May. I never saw individuals feeding alone and it was not easy to get near among the large flocks of waders. The *Fauna* gives the wing measurements as 100-111 mm. I shot two of 113.5 and 114 respectively.

2167. **Scolopax r. rusticola** Woodcock.

Easily overlooked but a regular winter visitor to the wet jungle all along the Pegu *yoma* where Mr. E. W. Bloech tells me he shoots a number every year. It is probably common right down to Rangoon but many of its haunts are never disturbed. Mr. E. W. Allan found it common at Sababontaung in the Henzada-Arakan *yomas* at about 3,000 ft.

2170. **Capella g. gallinago** Common Snipe.

All over Lower Burma, this bird appears to be a much later arrival than *stenura* and is a bird of the paddy (particularly the winter planted *mayin* paddy) and of the jheel-side, whereas *stenura* is a bird of the grasslands and bogs round which cane-brake, etc., flourish.

2173. **Capella stenura** Pintail Snipe.

Arrives in mid-August in incredible numbers, and in addition to the large numbers shot, thousands are caught in hand-nets at night by professional fowlers, who use a wooden bell or *Kalauk* and a lantern. The *Kalauk* apparently deceives the snipe into thinking the fowler is a grazing buffalo.

2175. **Lymnocryptes minima** Jack Snipe.

This bird must be rare as I have never seen one, or heard of one being shot, except one obtained by Mr. E. B. Bloech, twenty-five years ago, near Ledaunggan in the Insein district. Mr. Bloech has probably shot more snipe in Lower Burma than almost anyone and he only remembers one other being obtained. Hume had one brought him from near Rangoon (BB., ii, 385).

[2176-79. **Pelecanus** sp.? Pelican.

Apart from a single bird seen swimming on the Victoria Lakes at Rangoon on December 14th, 1931—which was too far off to identify—I have never seen one in Lower Burma. I was assured by villagers that Pelicans still breed in the remnants of the forest along the right bank of the Sittang but I failed to get there in the breeding season. Most of the area where Oates found them has long since been cleared of its timber.]

2180. **Phalacrocorax carbo sinensis** Large Cormorant.

Seen on various jheels in Henzada, and on the Hlawga lakes where, according to Harington, it bred in January. A few haunt the *yoma* streams of Henzada.

2182. **Phalacrocorax niger** Little Cormorant.

Local name:—*Awyaw*.

Breeds at various places throughout Henzada district both in bamboo and toddy palms in company with *Bubulcus coromandus*, commencing in May.

2183. **Anhinga melanogaster** Indian Darter.

Common throughout the year.

2203. **Threskiornis melanocephalus** White Ibis.

I have seen large flocks in February in parts of Henzada and it is abundant on and near the sea coast in the Sittang-Rangoon River area.

2215. **Anastomus oscitans** Open-bill.

This bird was very common in April in the Yandoon Island, where it was spread all over the dry plain feeding.

2216. **Ardea purpurea** Purple Heron.

Occurs throughout the area but is nowhere common. Wickham believed it bred in Henzada but I did not discover it, and visited none of the large jheels in the rains.

2218. **Ardea cinerea** subsp. ? Grey Heron.

Very common on the Irrawaddy and Hlaing Rivers, large gatherings being observable on the backwaters in December and January. Oates did not find it breeding. It was also common on the tide-line in company with *Herodias alba.* I found a colony of about ten pairs with half-built nests in a huge *Ficus* tree in the Kwingauk Police Station compound (Henzada) on February 11th. They were not at all shy but were afterwards greatly disturbed by the huge influx of surrendered rebels in early March, 1931.

2223. **Herodias alba** subsp. Large Egret.

2224. **Herodias intermedia** subsp. Smaller Egret.

I have never been able to distinguish the latter in the field but *alba* occurs all over the area and on the sea-coast is remarkably common. As the tide comes in hundreds can be seen belly-deep in the shallow water often two or three hundred yards out to sea.

2225. **Egretta g. garzetta** Little Egret.

Seen in small numbers all over the area. The black legs and yellow feet are a noticeable field characteristic.

2226. **Bubulcus ibis coromandus** Cattle Egret.

Common in the whole area and breeds from May to August, often with *Phalacrocorax niger,* and usually in close proximity to houses.

2229. **Ardeola grayii** Indian Pond Heron.

Extremely common, especially on the huge expanse of grass-covered mud near the sea, where hundreds can be seen, looking oddly like Curlews in the distance.

2231. **Butorides striatus javanicus** Little Green Heron. ♂ 625.

Common along the smaller streams and found within tidal limits in forest. One shot on February 13th showed signs of being about to breed.

[♂ juvenile wing 183 mm.—C.B.T.]

2233. **Nycticorax n. nycticorax** Night Heron. ♂ 524.

Common, and I have seen some big breeding colonies in Henzada and Insein in the rains, often with Cattle Egrets and Cormorants, so that the din of the colony never ceases day or night.

The Burmese name 'lin-wet', which I believe to mean the 'twilight pig', aptly describes the confused squealing which goes on when a colony of Night Herons is waking up at dusk or returning to roost at dawn.

2237. **Ixobrychus s. sinensis** Yellow Bittern.

Rarely seen and possibly a summer migrant arriving to breed and leaving in October.

2238. **Ixobrychus cinnamomeus** Chestnut Bittern.

From the start of the rains, this bird becomes very common and conspicuous in Lower Burma and by no means crepuscular. Individuals can be seen chasing each other or flying to their nests at all hours of the day. In Henzada I saw none before May 24th but possibly like *Butorides striatus*, the breeding colonies split up over a wide area in the dry weather and are thus rarely seen. I found it breeding in July in bamboo with Cormorants, Cattle Egrets and *Dupetor flavicollis* near Henzada.

2239. **Dupetor flavicollis** Black Bittern.

I found it breeding in July in bamboos along a stream in Henzada, with Cattle Egrets, *Ixobrychus,* Cormorants, etc., and repeatedly saw birds flying high from the Hlawga Lakes (Insein) in the rains to a nesting ground some two miles away to the South-West.

Except in the rains, I have never seen it.

2240. **Botaurus s. stellaris** Bittern.

I flushed one in February 1930 out of rough grass on the huge Kya-in swamp in the Bawle Island in Insein. I failed to secure it but was quite satisfied of its identity. This is much larger, and quite unlike, any of the other Burmese Bitterns.

2247. **Sarkidiornis melanotus** COMB DUCK.
Occasionally seen in Insein and Henzada but owing to persecution by Burmans, it is getting a rare bird now.

2248. **Asarcornis scutulatus** WHITE-WINGED WOOD DUCK.
I saw a pair in December 1925 in the Paunggyi valley of the Insein district, and it probably survives still in the remote and heavily-wooded jheels of the *yoma* foothills. Oates (BB., ii, 281) was very sceptical of its occurrence in Pegu, but in this country it could be easily overlooked and Mr. C. E. Milner tells me he saw it in Tharrawaddy before the war.

2250. **Nettapus coromondelianus** COTTON TEAL.
Very common indeed on certain jheels in Henzada and Insein up to March. After that these birds split up and breed all over the country, sometimes miles from water. Sir Harcourt Butler recorded some years ago a case of a Cotton Teal nesting in the roof of Government House.

GEESE.
I have never seen or heard of any geese in the area.

2260. **Dendrocygna javanica** LESSER WHISTLING TEAL.

2261. **Dendrocygna fulva** LARGE WHISTLING TEAL.
Both occur in Henzada and Insein but are much persecuted by every Burman with a gun, and no longer common. I shot *fulva* flighting to a patch of rice in the Bawle Island along with Pintail and other ducks.

2262. **Tadorna tadorna** SHELDRAKE.
I saw a pair on the Irrawaddy above Henzada on December 24th, 1930, as already recorded in the *Ibis*.

2263. **Casarca ferruginea** RUDDY SHELDRAKE.
Not uncommon above tidal limits. It is a bird of the sand. Two small parties seen flying west to east near Mingaladon on November 21st were probably newly arrived immigrants.

2270. **Mareca penelope** WIGEON.
This seems to be a rare bird but Mr. Bloech tells me he has occasionally shot it on the Hlaing River in Insein.

2271. **Nettion c. crecca** COMMON TEAL.
Occurs throughout Henzada, Maübin and Insein in small numbers and I saw four with Garganey on a tidal creek close to the sea. This Teal and Garganey were the only ducks seen near the shore at all.

2274. **Dafila a. acuta** PINTAIL.
I have seen flocks in Henzada and shot birds in Insein but it is such a shy duck that it is rarely obtained, and haunts the big jheels in Maübin and the Bawle Island which are very difficult of access.

2275. **Querquedula querquedula** GARGANEY TEAL.
I saw large gatherings in February and March in various parts of the area and it is probably the commonest duck in the area in winter. I saw many on a tidal creek close to the sea in mangrove jungle on February 20th.
In the latter country *Nettion albigulare* is likely to occur as it has been obtained in the Bassein district.

2276. **Spatula clypeata** SHOVELLER.
Not common. I saw a pair of drakes on the big *Ye-gyi* swamp in Henzada in February 1931 and Mr. Bloech has occasionally shot it in the Insein district.

2283. **Nyroca f. fuligula** TUFTED POCHARD.
I have seen small parties on the Kya-in swamp in Insein and near Letpanbin in Henzada.

2292. **Podiceps ruficollis capensis** INDIAN LITTLE GREBE. 574.
Seems to be resident and not uncommon. Several pairs were breeding in borrow pits below the Eikpyet retirement in Henzada in July 1931. In summer this bird shows a bright yellow patch just in front of the eye, contrasting with the chestnut head.

A NEW DRAGONFLY FROM LOWER BURMA.

BY

Lt.-Col. F. C. Fraser, I.M.S. (Retd.), F.R.E.S.

While examining a series of *Tetrathemis platyptera* in my own collection, I came upon a couple of males from Mergui, Lower Burma. There was nothing in them to excite interest except that I did not remember receiving any of that species from Lower Burma. I examined the markings to see if there might be any racial differences present but except that the labrum bore two basal spots of yellow and the terminal segments of the abdomen were unmarked I could see no departures from type. The absence of abdominal markings could be explained by decomposition changes obliterating them after death. The wings bore no trace of the usual basal yellow colouring but this is not uncommonly absent in teneral specimens. I was about to put them aside when I chanced to glance at the venation of the wings and was astonished to find that this differed entirely from that of *Tetrathemis*. It would be difficult to find two insects of different genera so closely alike in size, colouring and markings, and it was therefore not difficult to see how they had come to be overlooked on first receipt. This is not a case of mimicry but one of similarity by convergence probably brought about by the response to similar local influences and surroundings.

These two specimens belong to a new genus which by its archaic characters lies at the base of the family *Libellulidae* and form a connecting link between the two first groups as defined by the late Dr. F. Ris, viz., groups *Tetrathemis* and *Amphithemis*.

Systematic.

Genus: *Phyllothemis* gen. nov.

Head moderately large; eyes meeting broadly; forehead markedly rounded and without a frontal ridge; frontal sulcus shallow; vesicle high, two-pointed. Posterior lobe of *prothorax* rather large, rounded, not fissured at its middle; *thorax* rather small. *Legs* long and slim; hind femora with a row of very small, very closely-set spines of even size throughout; *abdomen* short, slim, dilated at both ends, cylindrical in the middle segments; *genitalia* prominent, the lamina very large, hood-like and projecting markedly, the hamules small and inconspicuous. *Wings* hyaline, uncoloured, narrow, the hind not noticeably broader than the fore; reticulation moderately close; discoidal cells at the same level, that of forewing with but a slight and very distal bend in its costal side, triangular, its distal and basal sides decidedly longer than the costal, that of the hind slightly or markedly distal to the level of the arc, both entire; arc between the second and third antenodal nervures; sectors of arc with a long fusion; *Cuii* and *IA* arising together from the anal angle of the discoidal cell in hindwing; 11 to 12 antenodal nervures, the last complete; *Rspl* indistinctly built, only a single row of cells between it and *IRiii*; 1 cubital nervure in forewing, 2 in the hind; no accessory nervures to the bridge; all *hts* entire; 1 row of cells in the discoidal field for a distance of 4 to 5 cells, after which the field is widely dilated to the border of wing; anal loop very small, made up of 5 to 6 cells only; pterostigma rather short; membrane nearly obsolete. Genotype: *Phyllothemis eltoni* sp. nov.

Phyllothemis eltoni sp. nov.

Male.—Abdomen 19 mm.; hindwing 22 mm.

Head: labium bright citron yellow the middle lobe at its centre and the lateral lobes at their borders broadly black; labrum black with two triangular basal citron yellow spots; face bright yellow as also a large spot on each side of frons, the latter and vesicle dark metallic blue; occiput dark brownish black; eyes probably green during life. Prothorax black, the anterior and posterior lobes bright greenish yellow, the latter narrowly black at base; thorax black dorsally marked with a narrow antehumeral greenish yellow stripe on each side and an oval humeral spot above, which lies transversely and is confluent with the yellow antealar sinus; laterally greenish yellow with a very broad black median oblique stripe; black beneath. Legs black, coxae and trochanters yellow; abdomen black marked with citron yellow as follows:—segment 1 with a large quadrate spot on each side; segment 2 with two large baso-lateral spots and a small rounded spot on its middle; segment 3 with a tapering stripe on each side and a linear spot on the middorsum beginning after the jugal suture; segments 4 to 7 with the median stripe-like spot only. Anal appendages twice the length of segment 10, superiors curved, dilated at the apical end, acutely pointed at apex and with a ventral spine below just before the apex; inferior triangular, its apex upturned. Female unknown. Type in my own collection.

Distribution: King Island, Mergui, Lower Burma. Two males taken by Mr. J. Elton Bott, during September. This species closely resembles *Tetrathemis platyptera* and cannot be distinguished from it on the wing, nor without examining the venation, save by the presence of two yellow spots on the labrum. The genus appears to lie somewhere near *Orchithemis* but is distinguished by the genitalia, the discoidal cells untraversed as well as the *Hts*, by the anal loop better formed and *Cuii* arising from the anal angle of discoidal cell, etc.

THE BUTTERFLIES OF SECUNDERABAD.

BY

LT.-COL. W. E. M. LOGAN HOME.

As no article on Secunderabad butterflies seems to have appeared in the *Journal*, I thought it might interest readers to know what species occur there. I have included all butterflies met with in a radius of 10 miles of the Secunderabad Club, though as a matter of fact, the majority of species I actually caught in my own garden, ½ mile from the Club. The period covered was one year, from February 1933 to February 1934.

A. PAPILIONIDAE.

1. **Tros hector** (Ev. A. 2. 9). Common everywhere throughout the year.

2. **Tros aristolochiae aristolochiae** (Ev. A. 2. 10). Common everywhere throughout the year.

3. **Papilio polymnestor polymnestor** (Ev. A. 4. 1. b). Rare; two seen, one in the Residency garden in Hyderabad in March 1933 and one in my garden in February, 1934.

4. **Papilio polytes romulus** (Ev. A. 4. 25) N.R. throughout the year.

5. **Papilio demoleus demoleus** (Bv. A. 4. 27. *a*). Common everywhere throughout the year.

B. PIERIDÆ.

6. **Delias eucharis** (Ev. B. 6. 3). Very common everywhere. This butterfly appears to be more richly coloured in the Secunderabad area than elsewhere; I have compared specimens with those taken from Coorg, Nilgiris, Deolali, Ajmer, etc., many of the ♀♀ taken in my garden were yellow on the upperside as well as underside. I have not seen this in specimens elsewhere; perhaps some members could give some further data about this?

7. **Belenois mesentina mesentina** (Ev. B. 8. β). Common in the gardens in the cantonment, less common outside. This species also appears to be more highly coloured in Secunderabad than elsewhere in India.

8. **Huphina nerissa evagete** (Ev. B. 9. 2. *a*). Common everywhere.

9. **Catopsilia crocale.** Not common. A few seen at the end of the Monsoon.

10. **Catopsilia pomona.** Rare. One taken during the Monsoon.

11. **Catopsilia pyranthe.** Common during the Monsoon months. Not seen between October to June.

12. **Terias libythea** (Ev. B. 15. 1). Very common everywhere.

13. **Terias mecabe simulata** (Ev. B. 15. 5. *a*). Common during the Monsoon; scarce from October to June.

14. **Ixias marianne** (Ev. B. 17. 1). Common during the Monsoon. Not seen afterwards.

15. **Ixias pyrene frequens** (Ev. B. 7. 2. β). Not common. A few seen in the jungle towards close of the Monsoon.

16. **Colotis fausta fulvia** (Ev. B. 18. 4. *a*). N.R. Met with throughout the year, chiefly in grass jungle.

17. **Colotis e. etrida** (Bv. B 18. 5. β). Common in the scrub jungle outside the cantonment.

18. **Colotis danae danae** (Ev. B. 18. 7. *a*). Not common. A few seen in the grass jungle. Those caught appeared to be larger and more highly coloured than Coorg, Deolali and Palnis specimens.

19. **Pareronia valeria hippia** (Ev. B. 20. 3). N.R. This species appeared at the end of the Monsoon and disappeared again in January.

C. DANAIDAE.

20. **Danais limniace mutina** (Ev. C. 2. 9). Not common. An occasional specimen seen in my garden and outside the cantonment.

21. **Danais plexippus** (Ev. C. 2. 12). Not rare. This species was not seen till the Monsoon, it occurred up to January.

22. **Danais chrysippus** (Ev. C. 2. 15). Very common everywhere.

23. **Euploea core core** (Ev. C. 3. β). Not rare. This species was not seen till October; it continued till February.

D. SATYRIDAE.

24. **Mycalesis mineus polydecta** (D. 2. 10. *a*). Not rare. It did not appear till the end of the Monsoon and disappeared in January.

25. **Lethe europa ragalva** [D. 3. 23. (24*a*)]. In my garden. The specimen caught has very much longer 'tails' than I have seen elsewhere.

26. **Ypthima asterope mahratta** (D. 14. 6). Common in the scrub jungle outside cantonments.

27. **Melanitis leda ismene** (D. 22. 1). Common everywhere.

F. NYMPHALIDAE.

28. **Charaxes fabius fabius** (Ev. F. 1. 7. β). Rare. 2 seen; one sitting on lantana, when I hadn't a net.

29. **Eriboea athamas agrarius** (Ev. F. 2. 2. β). Rare. 1 only seen.

30. **Euthalia nais** (Ev. 28). Not rare. Seen throughout the year, generally in rocky jungle.

31. **Neptis hylas varmona** (Ev. F. 26. 6. *a*). Not common. Seen at the end of the Monsoon occasionally.

32. **Hypolimnas misippus** (Ev. F. 30. 1). Very common everywhere.

33. **Hypolimnas bolina** (Ev. F. 30. 2). Not rare. Mostly seen outside the cantonments.

34. **Precis hierta hierta** (Ev. F. 35. 1. *a*). Not rare; never very common; but met with throughout the year, in the proportion of about 1 to every 100 *P. orithya.*

35. **Precis orithyea swinhoei** (Ev. 35. 2. *a*). Very common everywhere.

36. **Precis lemonias vaisya** (Ev. 35. 3. *a*). Very common everywhere.

37. **Precis almana almana** (Ev. 35. 4). Not rare; generally round paddy-fields.

38. **Precis atlites** (Ev. 35. 5). Not common. A few seen at end of the Monsoon round some paddy-fields 8 miles out of Secunderabad.

39. **Precis iphita pluviatalis.** Rare. Only one seen, in my garden, during the Monsoon.

40. **Vanessa cardui** (Ev. F. 36. 1). Not rare; from October to February.

41. **Atella phalanta** (Ev. F. 42. 1.). Common at the end of the rains for about 2 months, after which it was seldom met with.

42. **Ergolis ariadne indica** (Ev. 40. 1. β). Common during the Monsoon months till October, after which it disappeared.

43. **Telchinia violae** (Ev. F. 52). Very common everywhere throughout the year. The commonest butterfly in Secunderabad. The larvae swarmed all over the 'Mudpot' golf links throughout the year.

H. LYCAENIDAE.

44. **Spalgis epius epius** (Ev. H. 8. *a*). Rare. Only one seen, in my garden, in January.

45. **Castalius r. rosimon** (Ev. H. 11. 1). Not rare, at the end of the Monsoon, after which it disappeared.

46. **Tarucus nara** (H. 12. 9). Rare. A few seen during the Monsoon.

47. **Syntarucus plinius** (H. B). Not rare; at the end of Monsoon and up to March.

48. **Zizeeria trochilus putli** (H. 24. 1). Not rare; after the Monsoon till March.

49. **Zizeeria lysimon** (H. 24. 4). Not rare; throughout the year.

50. **Zizeeria otis decreta** (H. 24. 6. *a*). Very common everywhere throughout the dry months, scarce during the monsoon.

51. **Catacrysops strabo** (H. 27. 1). Not rare during and at the end of Monsoon; scarce in the dry months.

52. **Lampides boeticus** (H. 28). Common throughout the year.

53. **Jamides bochus** (H. 29. 1. *a*). Not rare during the Monsoon, after which it disappeared.

54. **Jamides c. celeno** (H. 29. 5. β). Common everywhere during the Monsoon, scarce afterwards.

55. **Nacaduba n. nora** (H. 32. 15). Not rare at the end of the Monsoon; it gradually disappeared.

56. **Nacaduba dubiosa indica** (H. 32. 16). Common throughout the Monsoon up to January.

57. **Curetis thetis** (Ev. H. 44. 1). Not common. A few seen, mostly ♀♀, during the Monsoon months.

58. **Spindasis v. vulcanus** (H. 57. 1. β). Not rare during the Monsoon and up to January, after which it was not seen.

59. **Spindasis i. ictis** (H. 57. 6. β). Rare. A few seen and 2 caught in August flying round a single tree at the top of a hill. No others seen anywhere.

60. **Tajuria jehana** (H. 60. 18). Common at the end of the Monsoon, not seen from December to July; noticeably smaller than Bombay specimens.

61. **Rathinda amor** (H. 76). Rare. Only 1 seen.

62. **Rapala schistacea** (H. 85. 12). Not common. Occurred during the Monsoon months till December.

63. **Rapala melampus** Not rare. Just seen in August, when a number were seen flying round the same tree where *S. ictis* were seen. Later I caught it in my garden in January.

I. HESPERIIDAE.

64. **Hasora a. alexis** (Ev. I. 1. 16). Appeared in numbers in July-August, not seen at any other time. This insect only flew at dawn and dusk, disappearing during the day-time, like Asthopaetus, Capila etc.

65. **Coladenia indrani indra** (Ev. I. 20. 2. β). Not rare during the Monsoon.

66. **Gomalia elma albofasciata** (Ev. I. 27. *a*) Rare. 2 only seen and caught, in my garden, in August.

67. **Syrichtus galba** (Ev. I. 28. 2). Common everywhere throughout the year.

68. **Suastus g. gremius** (Ev. I. 47. 1. β). Common everywhere throughout the year.

69. **Astycus augias** (Ev. I. 91. 1. *a*). Rare. Only 1 seen in September.

70. **Baoris b. bevani** (Ev. I. 97. 34. β). Common throughout the year.

SOME OBSERVATIONS ON *NYMPHAEA PUBESCENS* WILLD.

BY

CHARLES McCANN, F.L.S.

(*Assistant Curator, Bombay Natural History Society*).

(*With two plates and one text-figure*).

The Water-Lily, *Nymphaea pubescens*, needs no introduction. It is a plant common in most tanks and pools in India. Though so common, much of its life-history is still obscure. The observations recorded in this paper are based purely on field study—a close observation of the plants in their natural habitat. D'Almeida has contributed an interesting paper on this *Nymphaea* to the Journal of the Indian Botanical Society, vol. v (1926), p. 62.

DESCRIPTION.

Rhizome: To understand the true nature of the rhizomatous stem of *N. pubescens* it is best to follow its development from the seedling, and its subsequent growth. In my opinion, *N. pubescens* does not flower in the first season or two (perhaps more) of its existence—not until such time as the rhizome is large enough to contain a fair surplus of reserve material. In shallow water the activity of these plants is very limited. During the first season of its activity the young plant develops a rosette of a few small submerged leaves, and a few roots. Amidst the roots a small ovoid or rotund 'tuber' is developed—the future rhizome.

The plant next rapidly produces three or four small leaves, as many roots, and a small rhizome. The young plant grows near the margin of the tank in shallow water, and as the water dries up the leaves disappear and the newly formed rhizome is left to tide over the dry season. Activity is resumed with the next monsoon, the plant producing larger and more numerous leaves and roots and ultimately a larger rhizome, and so on year by year till the rhizome is large enough to produce flowers and fruit.

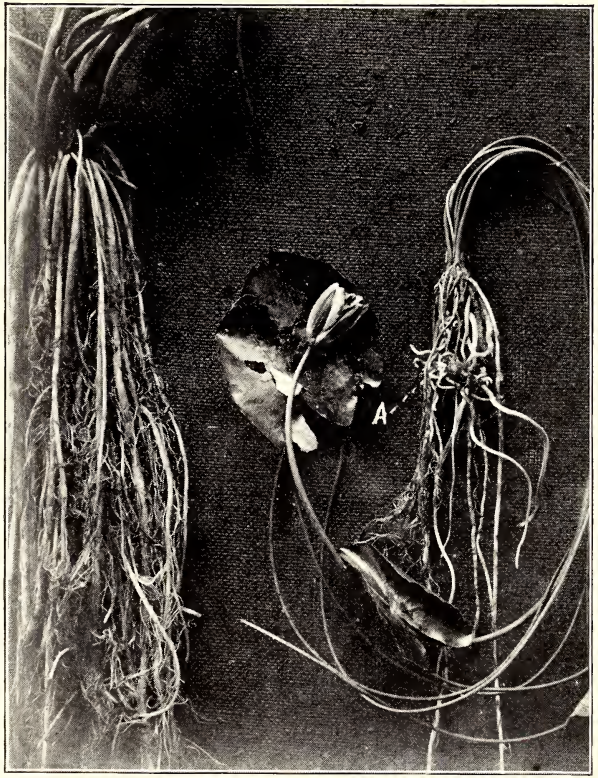
At the close of each vegetative season and the drying up of the pool the leaves, and finally the roots, are lost. The rhizome may then be found either free on the surface or imbedded in the soil. If free, the rhizome may be washed into a deeper portion of the pool with the rush of water at the break of the next monsoon.

The rhizome during the vegetative period always anchors itself to the substratum by numerous spongy roots developed at the base of each petiole or from any point lower down. D'Almeida affirms that 'the rhizome is not buried in the mud at the bottom of the pond like those of other Water-lilies'. Whether the rhizome is only anchored to the substratum by roots or imbedded in the soil is, in my opinion, a matter of circumstance. I have found rhizomes anchored and imbedded—this would depend on the movement of the silt at the bottom of the tank. During the dry weather the rhizomes retain their roots as long as there is moisture in the soil, but in the case of anchored rhizomes the roots soon die away leaving the rhizomes free on the surface. When thus situated, rhizomes may be moved about freely by various agents. It is only necessary to dig up the bed of a tank where *Nymphaeas* are known to grow, during the dry season, to see the number of rhizomes that are turned out!

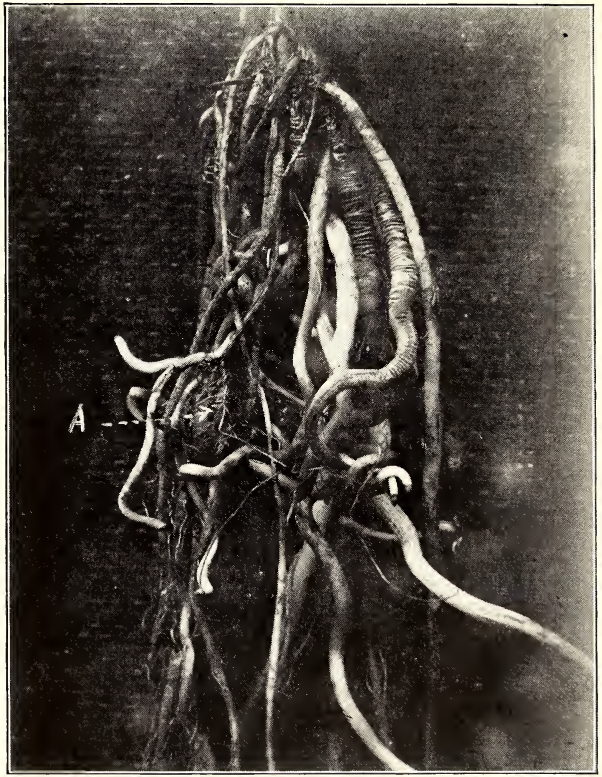
With the break of the next monsoon the free rhizomes may be seen rolled about by the inrush of water. They usually keep moving about at the water level till fresh roots are developed which anchor them. Numerous rhizomes are cast about in this way. An examination of one of these free rhizomes, particularly if it be an old one, may show that its lower end is in a partially decomposed condition. This decomposing portion is sometimes broken off by the action of the water, leaving only the active portion which soon grows a fresh outer coating around the exposed tender tissue (solid rhizomes do not float). In some cases the decomposing area is so large that it acts as a float due to the gases within. In this way the rhizome is kept at the surface of the water for a considerable time—until the decomposed area falls away from the active portion, which sinks to the bottom. In this way an active rhizome is carried about from one part of the tank to another by currents and wind. It generally comes to rest near the bank or it may sink anywhere as it is blown across the tank. This may possibly be a natural device to enable the plant to change its ground!

Normally, the rhizome grows vertically imbedded in the substratum. With the advance of growth and the rise in the level of the soil it tends to elongate and it becomes broader above. It may be described as obovate or spindle-shaped. I have frequently obtained such rhizomes measuring 20-25 cm. long and about 10 cm. broad when in the fresh state; but they shrink very much when dry. Generally the rhizome has but a single growing point, but may frequently 'branch'—showing several growing points. Possibly these 'branches' eventually separate by forming absciss layers. This point needs further investigation. As the rhizome elongates, the lower portion decomposes internally, leaving a hard woody shell. At the death of the rhizome the roots are lost, leaving it free in the substratum. Presumably, due to the decomposition gases within the outer shell, the entire rhizome rises out of the soil and floats to the surface of the water. Hollow rhizomes are frequently found floating in tanks. They form excellent harbours for aquatic insects.

Another point worthy of note is that rhizomes occasionally produce secondary ovoid or roundish 'tubers', 1-4 cm. long, on short or long stolons (Plate I, 1, A). This I have noticed in anchored and imbedded rhizomes both young and old. Surrounding an anchored rhizome, I once found several detached roundish 'tubers' which had evidently separated from the parent rhizome to which

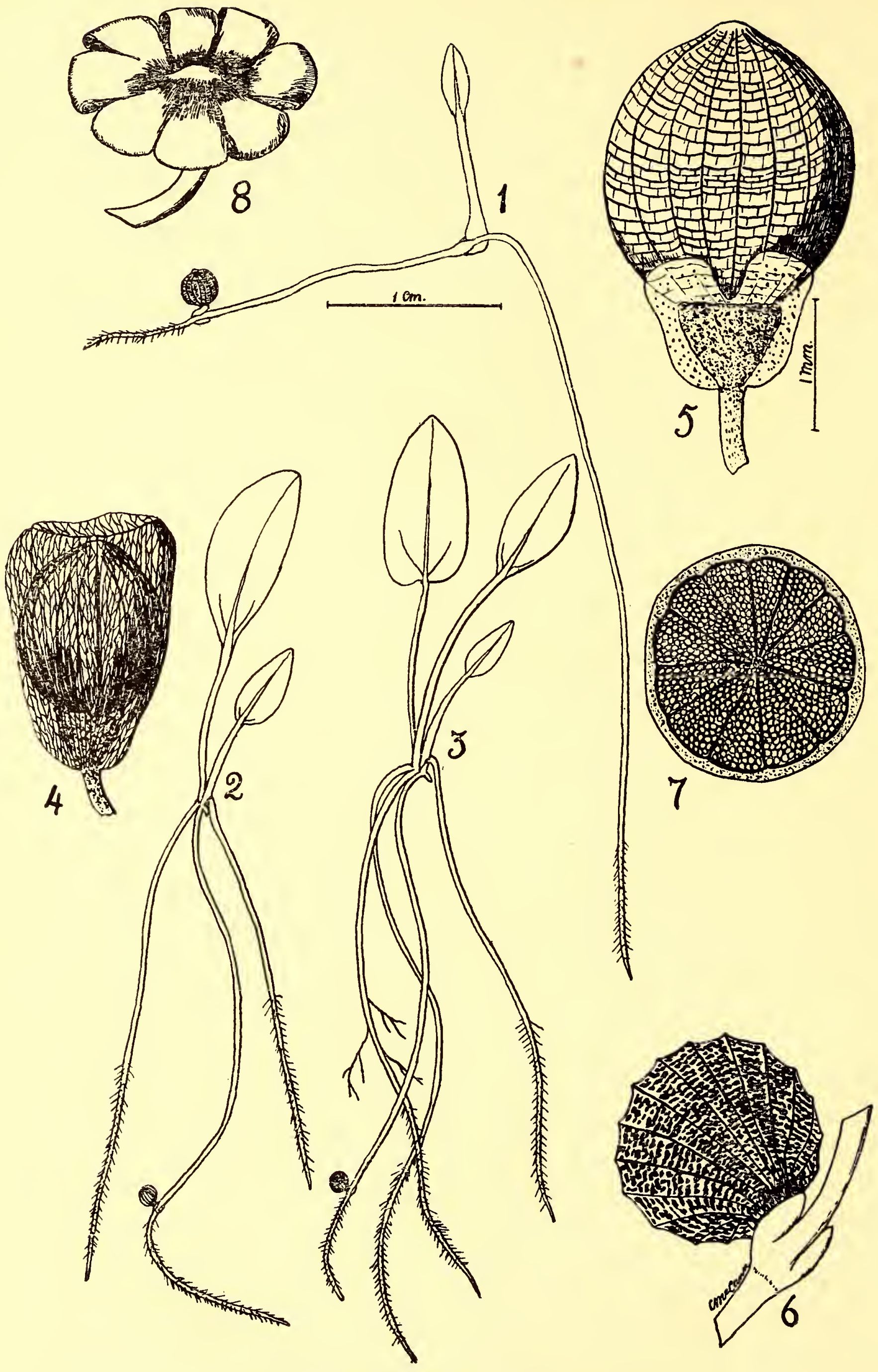


1. Root system of *Nymphaea pubescens* Willd., normal roots (left); abnormal roots (right). (Note small 'tuber'.)



2. Abnormal root system of *Nymphaea pubescens* Willd., showing wrinkled roots. (Note small tuber at A.)

Photos by Author.



Nymphaea pubescens Willd.

1. A seedling with the first leaf. 2 & 3. Further stages of the seedling. 4. Seed within aril. 5. Seed with partially developed aril. 6. Portion of germinated seed. 7. Section of fruit showing septa. 8. Dehisced fruit showing recurved segments.

there were still two or three attached. When rhizomes are imbedded in slush, hastate, sagittate or linear leaves are produced till the ground dries up, when all vegetative growth is arrested. The rhizome is surrounded by a protective covering of long silky hairs sometimes interspersed with scale-like appendages which, in my opinion, are the remains of the wings of the petioles.

Roots: The roots of *N. pubescens* are adventitious. A fresh crop is produced each season in plants which are in tanks that dry up, but when in perennial water, new roots continually sprout. D'Almeida (l.c.) writes, 'Associated with each leaf-base are usually two roots, sometimes one, rarely three'. I have observed that at the base of each petiole there are generally three roots produced (Text-fig. 1, D), of which one, two, or all, may develop equally at the same time. However, this point often varies with different individuals. These roots are stout and spongy, and form the main root system [Pl. I, fig. 1 (left)]. Each one may reach a yard, rarely more, in length. At first they are greyish white becoming eventually white or sometimes stained russet. The extremity of these roots is protected by a well-developed, yellowish root-cap. After these roots have entered the substratum they develop numerous, lateral, filamentous, branching roots; but the main roots themselves never branch.

D'Almeida (l.c.) under the subheading of roots writes: 'Ordinarily the roots serve to anchor the rhizome to the soil and absorb nutriment therefrom. But occasionally some roots function as *pull-roots* and by their contraction bring about a firmer anchoring of the plant in the mud and thus prevent the rhizome (which we have seen is not buried in the mud but merely held down to the surface of the earth by its roots) from being swayed about by the movements of the water. . . They can be recognised at once by their transverse wrinkling.' After examining several dozen specimens during the vegetative period, I am forced to the conclusion that such 'pull-roots' (*sensu stricto*) do not exist in *N. pubescens*, and that the wrinkled roots [Pl. I, fig. 1 (right) & fig. 2] occasionally found, result from the roots meeting with firm resistance, and being thus confined within a circumscribed area. When growing in soft mud the roots are all straight and long without any wrinkles. The roots spread out in all directions near the surface of the substratum. But, should the roots meet with resistance or grow in a pot-hole, or the like, they tend to form spirals, and many of them become very decidedly wrinkled. A point about these roots is that they are much firmer in consistency than roots that are able to spread out. In all cases I have carefully examined the substratum before removing the plants. This I have done by means of a stick, and also by going under water when necessary.

Leaves: The size, texture and shape of the leaves are dependent on the size of the rhizome, on the amount of moisture and water present, and on whether the apex of the rhizome is submerged or not at the time when the leaves are developed. The seed at first develops a single small broadly lanceolate leaf (Plate II, fig. 1). This is soon followed by larger membraneous submerged leaves which eventually form a rosette. The margins are entire, the upper surface pale green, the underside is a paler glaucous green rarely tinged with purple. Young plants have small leaves on thin petioles. Old rhizomes, which are partially submerged or in damp soil during the hot weather, produce erect, short petioled, hastate, sagittate, or linear leaves above the surface of the water, or if submerged, near and above the surface. These are really the 'dry season' leaves which appear just before the plants aestivate, and not during the monsoon. Whether such leaves would be produced under artificial conditions at any season, I am unable to say. These 'dry season' leaves are uniform in colour on both surfaces, unlike the floating 'monsoon' leaves which are purplish beneath. Again, the margins of the 'dry season' leaves are usually entire. In texture they are more or less membraneous. Plants in deep water throughout the year, produce the regular floating 'monsoon' leaves. During the monsoon which is the true vegetative period of *Nymphaea*, the floating leaves are produced on long, almost cylindric petioles, the length of which depends on the depth of water the plants happen to be growing in, or upon the available space for their even distribution on the surface of the water. At the base of the petioles there are usually two linear-oblong wings adnate by their inner margins to the petiole for the greater part of their length (Text-fig. 1, B & C), the upper portions alone being free and ending in acute or subacute tips. These wings separate from the petiole when the latter increases in diameter, and often remain as 'scales' attached to the rhizome, or fall away entirely. Thus it is that many of the older leaves appear

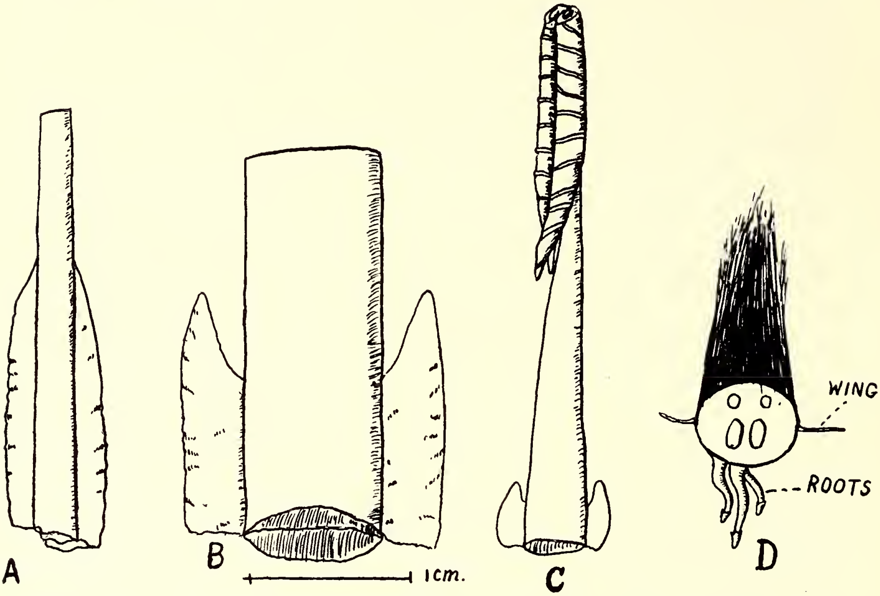


Fig. 1.—A. Wings of petiole in young plant. B. Wings of petiole of old plant. C. Wings of a young leaf of an old plant. D. Section of petiole showing wings, roots and 'hairy' stipule (Diagrammatic).

wingless. D'Almeida in regard to the wings (stipules) of the petioles says: 'In the early juvenile form of the leaves the stipules are absent, but in the later ones they occur as slight lateral wings of the base of the petiole.' I have observed that these wings are present throughout, but to a varying degree according to the age of the plants. In all young plants the wings to the petiole are generally narrow and adnate to the petiole throughout their entire length (Text-fig. 1, A), whereas in the leaves of older plants, the wings are free above from a very early stage.

Partially surrounding the base of each petiole is a fringe of fine long, white, silky hairs (when dry) (Text-fig. 1, D). In young leaves these hairs are so united as to appear like membraneous adaxial stipules (as which I regard them). On 'dry' rhizome these hairy appendages form the fluffy protective covering. These 'membraneous' appendages are, in my opinion, really adaxial stipules transformed to serve a dual purpose. Occasionally such a transformation from a membraneous to a fimbriate appendage is seen in the development of the ligules of some of the *Gramineae*.

Flowers : *N. pubescens* commences to flower about mid-July and continues to do so as long as there is sufficient water. During the dry season flowers are scarce even in perennial water. The size of the flowers is, I believe, in proportion to that of the rhizome —the oldest rhizomes producing the largest flowers, as already indicated. The peduncles, like the petioles, vary in length with the depth of water. There are no membraneous wings at the base of the peduncles. The flowers are partially nocturnal and partially diurnal. At about 7 p.m. they commence to open and remain open all night, closing next day about noon or a little before.

Fruit : After fertilisation the flowers do not open again, and no longer stand erect on their peduncles out of the water. Henceforth the young fruit gradually sinks as it matures, and generally remains just below the surface of the water till ripe when it rises to the surface once more. After fertilisation, the petals are the first segments of the perianth to decompose and fall away. During this time the sepals usually become green and foliaceous, but they too soon fall away. The broad filaments of the anthers are yellow in the fresh flowers; but now they undergo a remarkable change. They gradually lose their yellow colour, increase in width and thickness, turn green, and lose the upper portion which supported the anthers. In this condition the filaments remain as a persistent crown to the fruit. The outermost are the largest, diminishing in size towards the centre. The outer frequently show lines of 'union' on the outside of the fruit giving the appearance as though the carpels of the fruit were composed of fused filaments. The extremities of the outer rings of enlarged filaments are usually recurved, while those of the inner ones are incurved. Eventually the outer coat of the fruit splits more or less regularly into 8-10 segments which become strongly reflexed (Pl. II, fig. 8) the apical 'corona' of filaments coming away in the form of a disc. The seeds float for some time and are blown about by the wind.

The fruit is globose, internally divided by 12 radial septa to which the seeds are attached by short stalks (Pl. II, fig. 7).

Seeds: The seeds are numerous, 2 mm. (excluding the aril), rotund, slightly umbonate, 14-16 longitudinal ribs, trabeculate (when young) becoming mottled with age (Pl. II, fig. 5); reddish brown or brick red in the indehisced fruit, becoming green when they leave the aril and eventually mottled with brown when old. Each seed is contained in a transparent funnel-shaped aril (Pl. II, fig. 4) which on contact with the water swells considerably, finally becoming mucilaginous. The aril is marked with fine reticulations. When the arils swell to their fullest the seeds drop through the mouth of the 'funnel' and sink to the bottom. The aril acts as a float.

Habitat: *N. pubescens* is commonly found in all the still waters of the Bombay Presidency, often associated with other members of the same genus, *Limnanthemum* spp., *Potamogeton* spp., *Pseudoraphis aspera* Pilger, and many other aquatic and marsh plants.

Development of the Seedling.

The seeds when liberated from the fruit are generally blown towards the bank when they fall away from the arils and sink to the bottom. If the water does not dry up too rapidly, there is no long period of rest and the seeds soon germinate in the shallows; but should the water dry, the seeds do not germinate till the next monsoon.

On germination the seed produces a single radicle and two small cotyledons between which arises a short or long stolon-like process at the extremity of which is developed a single small broadly lanceolate leaf and a single adventitious root (Pl. II, fig. 1). The first leaf is soon followed by another larger and broader one and so on till a small rosette is formed (Pl. II, figs. 2 & 3). Accompanying each leaf is a root at its base. At the point where the first leaf is developed a small rhizome is produced. In the following period of activity a fresh rosette of leaves is formed. These leaves are followed by small floating leaves year by year till the plants reach maturity. The seed-coat persists for a considerable time before it falls away to be washed up at the break of the next rains. In this condition large quantities of shells may be seen floating about.

Dispersal.

Seed: The dispersal of seed may be attributed to many agencies. Wallowing animals undoubtedly carry away numerous seeds adhering to their bodies. The buffalo, for example, would be an excellent dispersing agent in India. It wallows in the rapidly drying boggy beds of tanks and pools—just at the time when all the seeds are mature. Aquatic birds probably account for a large number conveyed in the small clots of earth sticking to their feet and feathers. Water is another excellent carrier of seed.

Rhizomes: Apart from the rôle water plays in the dispersal of the seeds, at the time of floods, rhizomes and even entire plants are washed away to great distances from the place of their origin. Finally whether accidentally or deliberately, Man is responsible for the transportation of seeds and rhizomes; as for instance when large quantities of earth are carried long distances off.

SUMMARY.

There still remains much to be studied with regard to the life history of *N. pubescens.* The few points touched on in this paper are the result of field observations made over a period of several years in the Bombay Presidency, chiefly in the Islands of Bombay and Salsette, where this species is extremely abundant. In situations which dry up soon after the rains the plant presents two almost distinct phases: (*a*) the 'monsoon' or true vegetative phase; (*b*) the 'dry season' or quiescent phase—at times one gradually passing into the other.

Normally the rhizomes are vertically imbedded in the soil, but they may occur only anchored to the substratum by roots—depending on circumstances. The rhizome often produces secondary 'tubers'. The dead rhizomes generally leave the substratum due to the formation of gases within their woody outer layers, and float to the surface. This is frequently observed also in 'free' active rhizomes which have their lower extremity in a state of decomposition.

The leaves vary in shape, size and texture according to the seasons and according to the age of the plant. All roots are of the absorbent type, and only become coiled and wrinkled as a result of resistance or confinement within a circumscribed area, giving them the appearance of *pull roots.*

NOTES ON THE HABITS OF SOME INDIAN BIRDS.

BY

CAPTAIN R. S. P. BATES, M.B.O.U.

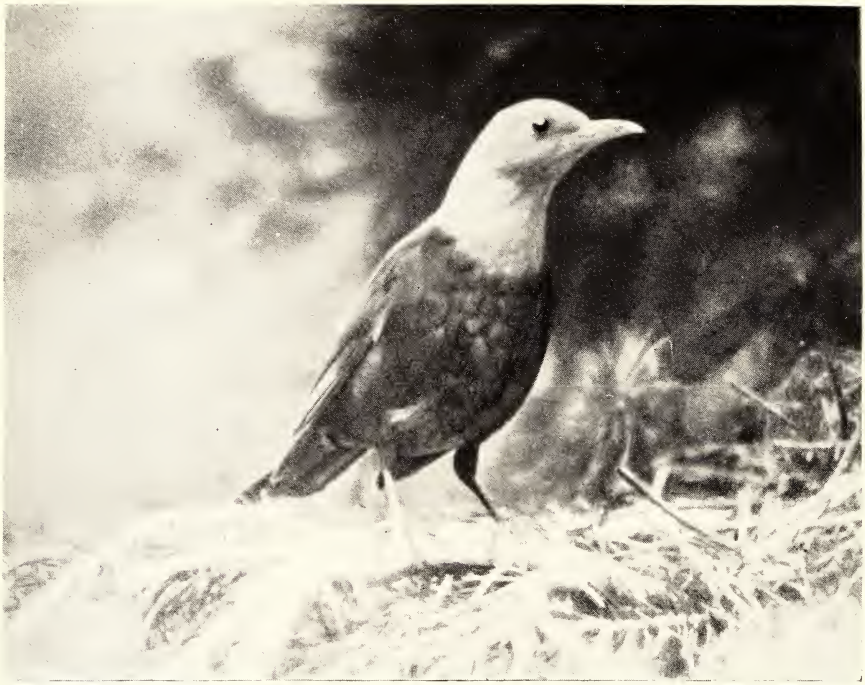
(*With three plates*).

In *Nidification of Birds of the Indian Empire*, vol. ii, p. 76, is a reference to Whymper's record of a nest of *Rhyacornis fuliginosa fuliginosa*, the Himalayan Plumbeous Redstart, built in a tree. Undoubtedly holes in banks and walls, and natural hollows in trees overhanging, or close to, the water provide the usual sites for these nests, but I can add three records of conventionally shaped ones built in forks of trees. The first, which was empty, was on the Madmatti River, near Bandipur, Kashmir, in the crown of a pollarded willow; date May 25, 1920. Moss and leaves formed the bulk of this nest. The second was in a fairly well concealed upright fork of a low willow on the bank of the same river about two miles further upstream; elevation approximately 5,500 ft. and date May 27, 1921. It was made mainly of moss lined with hair and thin grass, was about the size of a Hedge-Sparrow's nest, and contained four hard set eggs. The third and last was also in a fork of a willow tree on the landward side of a thick hedge a few yards from the Lidar River near Pahlgam Village (6,800 ft.). It might well have been that of a Hedge Sparrow, being substantially built of moss and a few leaves with a wool and hair lining. On May 31, 1932 it contained large young ones.

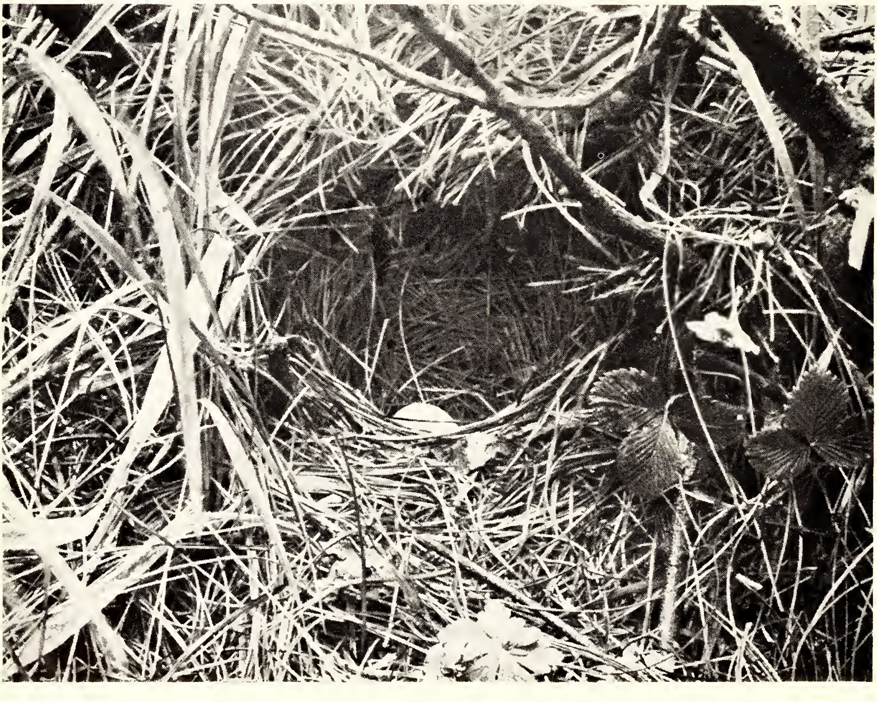
Incidentally nests are occasionally some distance from water. In addition to the one I found in 1921 fifty yards from the river at Lidarwat, two years ago I came across one at Tanin about the same distance up a steep slope overlooking the Astanmarg stream. It was in a hollow of a fallen tree. I put down the reflex camera while I looked at it. My spaniel came rushing up the hillside, bumped into the case and sent it spinning down into the torrent below. Fortunately it came to rest in shallow water. The only damage was a broken plate-holder!

At Lidarwat, late in July 1928, I came upon three very curiously placed nests, none of which, I might add, survived for any length of time. Crossing a tumbled down fence by the pathside I almost put my hand into a nest wedged into a slight recess at the top of a post. Another was in a slight indentation in the side of a gently sloping grassy bank, the sort of situation a Lark might choose, while the third was two feet from the ground stuck against the trunk of a pine tree by the water's edge. Someone had taken a chip out of the bark with an axe, the resultant depression accommodating about one third of the nest.

I see Buchanan and Whymper are quoted as finding cup-shaped nests of *Calliope pectoralis pectoralis*, the Himalayan Ruby-throat (*Nidification*, vol. ii, p. 82), but did Buchanan really mean cup-shaped without the semblance of a dome? Every nest I have



Grey-headed Thrush (*Turdus rubrocanus*) approaching nest. Pahlgam 7,000′, Lidar Valley, Kashmir.



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Nest of Blue-headed Rock Thrush (*Monticola cinchloryncha*), made largely of pine needles. Pahlgam 7,000′, Lidar Valley, Kashmir.

ever seen I would certainly describe as domed, but semi-domed would apply equally as well. Cup shaped would apply to none. The entrance is decidedly on the large side taking into account the proportions of the nest, and is situated towards the top, thus displacing the better part of half the dome, but the structure still inclines towards the shape of a coconut with a piece cut out of it.

And what does Mr. Stuart Baker mean when he says their nests are always in the open? On open ground above the tree-line —yes, but a most favoured situation is in the roots of juniper where it grows in patches on the hillsides. Usually the nest is near the outer edge of its patch where the scrub is but one or two feet high. So far I have not been lucky enough to find a nest in any other situation, and nests in grass tufts on open hillsides have never come my way. This may of course account for my never having found a cup shaped affair.

On the subject of the Western Grey-headed Thrush (*Turdus rubrocanus rubrocanus*) I feel I could really spread myself, but I will restrain myself as far as possible. The somewhat limited information in Hume's *Nests and Eggs* infers that nests are only to be found in banks. It seems to me that subsequently, taking this for granted, collectors, including myself, have hunted about at ground level, and with occasional success. Stuart Baker (*Nidification*, vol. ii, p. 119) has therefore been compelled to carry on the tradition, adding a note of Rattray's of a nest in a hole of a tree trunk up to ten or twelve feet from the ground, and that I found them building their nests in hollows in decayed stumps and considered such places were more often used than banks. This certainly was my impression until circumstances forced me to look elsewhere with immediate and most fruitful results.

Pahlgam was the scene of my enlightenment. Those who have visited that delightful spot will remember the shady path which leads through the extensive pine and mixed forests passing just above the little church to Rainspal Marg and on up the left bank of the East Lidar River.

On May 17 on the very edge of this path I found an empty nest built at eye-level on a couple of small horizontal branches and close up against the trunk of a pine tree. It looked uncommonly like a thrush's nest.

The following day while forcing my way through a little copse of young pines in a wood on the right bank of the West Lidar River, a bird fluttered out of the crown of one of the young trees, disclosing a nest about eight feet from the ground well concealed amongst the twigs. This contained three naked young but alas I had hardly seen the owner. As a lynx-eyed Jungle Crow was becoming unpleasantly curious, I beat a hasty retreat, but next morning watched a Grey-headed Thrush on to the nest.

My suspicions were now aroused as on the 19th I saw no less than three pairs of these birds while walking along the Rainspal path, and to quote from my diary for that day 'One had a nest well-concealed about nine feet up in the crown of a fir sapling. It contained one young one about a week old, so the egg or eggs must have been laid in the latter half of April. I did not realise that this bird was so common at only 7,000 ft., nor that it bred so early'.

Further extracts from my diary will complete the story. 'May 20.—Went up to Baisaran. Found a number of old or empty Grey-headed Thrush's nests in tree forks about six or eight feet from the ground. At length we found a lately deserted one at the top of the hill (8,000 ft.) with three somewhat bad eggs in it which I took. As if to show that the exception proves the rule, the nest was in the roots of a hazel only a few inches off the ground.'

'May 22.—Spent the morning in the woods on the left bank of the East Lidar. Within fifty yards of the Grey-headed Thrush's with one young one, found the following:—Another Thrush's with three eggs six feet up in the fork of a hazel; a Blue-throated Fly-catcher's being built. . . . Eventually I found two more Thrushes' against pine trunks, one five and one ten feet from the ground, the former with three eggs and the other with two new young and an egg. Also found two new but empty ones in same kind of site and a number of old ones.'

'May 26.—Found yet another Grey-headed Thrush's nest with the bird sitting on two eggs. Usual situation (six feet up in fork of hazel).'

'June 5.—Another Grey-headed Thrush's in the same old wood well-concealed against the trunk of a fir on the path-side. It is only five feet from the ground, contains three incubated eggs, and in an excellent position for photography.'

Between May 17 and June 5, I therefore found no less than eight nests containing eggs or young and at least an equal number of old ones and new ones being built. Out of these only one was near ground level, the remainder being against tree trunks, usually where a couple of horizontal branches sprang out together, and to a lesser extent in forks, varying from five to twelve feet from the ground. Some were very well-concealed, many far from it, but once having realised that far more nests were to be found off the ground than on it, I simply could not help discovering them. In character I found these birds very close sitters, though extremely wary in returning to nests containing eggs. They become bold and very fussy after the appearance of the young.

Of the Blue-headed Rock-Thrush (*Monticola cinclorhyncha*) in *Nidification*, vol. ii, p. 150, Stuart Baker writes as follows: 'Hume also notes that they sometimes incorporate pine needles in their nests but, though all my nests have been taken in pine wood country, I have seen no pine needles used, nor have I ever seen the birds breeding inside these woods, although they may be all round them.'

Near Pahlgam I know of a certain pine wood roughly quarter of a mile square. Through this wood runs a small but ever-deepening nullah, the pines growing down its sides. One or two channels, mere depressions forming sloping banks but two or three feet deep, run through the wood into the nullah. As is usual in pine woods undergrowth is conspicuous by its almost complete absence, though a few scattered brambles occur here and there along the nullah.

On June 5, when some thirty yards inside the wood at a point where the nullah was perhaps some fifteen feet deep with fairly steep banks, my wife's spaniel pushed his head into the base of one of the few bushes, whereupon a female Blue-headed Rock-Thrush burst out from under his very nose. So close had she sat that he could easily have caught her, but her flustered exit so startled him that all he achieved was to push a small twig through one of the four fresh eggs which the nest contained. Although so startled the bird made no sound and flew straight down the nullah till lost to view. The nest was composed almost wholly of pine needles with a few short lengths of quite stout twigs incorporated on the outside. I removed the broken egg and tidied up the nest but alas she deserted, as next day only one egg remained and this was quite cold.

Ten days later, hoping that this pair, which were still hanging about, might be nesting again I thoroughly searched every likely spot I could find in the wood. I traced no occupied nest but found two disused ones under the buttress roots of pines growing on the edge of one of the shallow channels. One of these was almost wholly made of needles; the other lined with them.

In 1931, on July 1, I stumbled on a nest of this bird when crossing the Hayan Pass on our way back to Srinagar from the Sind Valley. The surroundings of the nest were as follows:—Elevation about 9,000 ft. The bridle path we were on ran diagonally upwards across a steep slope. Above the path the pines grew thickly; below it the fall of the ground steepened and pines and other trees were somewhat scarcer. The nest was in a hollow formed by a sloping stone projecting from the bank on the inner side of the path. Its lining was of pine needles, the rest of the structure being of a little moss and some stout twigs with two or three really large pieces of bark buttressing up the front. It contained four eggs on the point of hatching.

Of its habits Stuart Baker states that he has always found both male and female shy during the breeding season, very loth to visit the nest when watched, and leaving it before an intruder approaches the nest very close. He does however go on to quote that Marshall and Cock found it otherwise. Personally I have found it an exceptionally close sitter. For instance in the case of the Hayan Pass nest the female only left when my boot—I was riding—literally brushed past the front of the nest. On another occasion I stood over a sitting bird for some minutes talking to the shikari who had spotted her, while as stated my dog nearly caught one though the nest contained fresh eggs. Once flushed, it is another matter. I have always found it to leave the nest with a swift direct flight, usually straight downhill, and to pass completely from view without uttering a sound. As regards approaching the nest when watched, Stuart Baker is undoubtedly correct. I have waited in vain for hours. And my only attempt at photographing one at the nest likewise ended in failure. Half an hour after entering the hide, the female descended to the edge of the nest, but hearing a slight sound from within, she left immediately and never appeared again although I waited the whole morning.

What is the incubation period of the Himalayan Whistling Thrush's egg? On May 18, I found a nest containing one fresh egg. By the 21st it held its full complement of four; that is, an egg had been deposited each day. Unfortunately I did not visit this nest again until June 9 when to my surprise I found four healthy naked young ones so large that they filled the nest cavity entirely. I judged them to be at least four to five days old, which places the incubation period in the neighbourhood of 14 days. This is shorter than I had expected it to be, but it is perhaps offset by the fact that the young ones remain in the nest a considerable time.

This note refers to Bareilly in the United Provinces. On July 21, 1932, I noticed a very busy little Tailor-bird (*Orthotomus sutorius sutorius*) making frequent visits to a small mango tree bordering a lawn. By August 2nd the female was sitting on eggs in a decidedly well concealed nest built within three drooping leaves carefully stitched together. It was a good nest for observation purposes being but six feet from the ground, but alas on the 7th I found it empty and slightly depressed on one side, as if a somewhat heavy creature had stood upon its rim.

Two days later I found that they must have immediately turned their attention to a croton on the verandah and here a new nest very rapidly appeared. Although decidedly conspicuous, and within six feet of where my bearer sat every morning cleaning my gear, this nest survived and a brood was successfully reared. I cannot say which bird was responsible for sewing the leaves together but I noticed that both helped with the construction of the nest within. Building activities ceased on the 11th and an egg was deposited on each of the three following days (I looked in at approximately 10 a.m. every day).

The female did not wait for the deposition of the full clutch, but commenced sitting on the 13th when the nest held two eggs. On the 25th at 10 a.m. I saw the female fly off with a piece of egg-shell in her bill and found that one egg had hatched out and that another egg was cracked. This had also hatched off by midday. As I expected the third young one appeared the following morning. The period of incubation was therefore 12 days.

When we went up to Pahlgam in May 1932 I hoped for photographs of the handsome Black and Orange Grosbeak (*Perissospiza icteroides*). Photographs of a sort I did obtain but not in the manner I had expected. When exactly do these birds breed at this level (7,000 ft.)? Very early on I suspect.

On arrival, May 17, I noted a pair, male and female, in the vicinity of the church. Another pair, also male and female, used to haunt our camp and were in the habit of hopping up quite close to the tent in the early mornings and evenings to crack the pine seeds unearthed by our servants in their passage to and from the so-called kitchen. It was through this that I got a photograph of a male. We were having a lazy afternoon in the tent when my wife heard the faint cracking of seeds just the other side of the flap. Cautiously pushing out the lens of the reflex, I found the image of a male Grosbeak taking up the whole of the focussing screen. Alas at that moment I had no sufficiently colour sensitive plate available, so the resultant photograph might well be of his dull coloured consort.

Towards the end of the month the female disappeared, but two males kept up the practice.

On June 4, I found myself constrained to write in my diary 'Have seen numbers of male Grosbeaks together the last few days'.

On the 9th, I wrote: 'In the afternoon two male Grosbeaks came to the tent. I took one through the window. One sees no females about now but the males are not alone and sometimes in flocks of four or five.' Where were the females?

Soon after this we moved to Tanin (9,000 ft.). Unfortunately I failed to keep a clear record of the Grosbeaks there. On June 24 I noted 'Saw a flock of at least half a dozen Grosbeaks'. Sex I did not state and I cannot now remember whether this refers to a roosting party which I disturbed late one evening. Coming down a steep hillside when the light was rapidly fading, I threw a stone into a patch of thick bushes about eight or ten feet high. To my surprise the place at once became alive with fluttering birds which dashed out on the lower side of the clump. Going quietly round I got my wife to throw in a couple more stones when out came more birds, those close enough to me to be recognised in the bad light turning out to be about half a dozen Grosbeaks. From their size and flight I think it more than likely that every one of the birds which came out was of this species. If so they must have collected from a wide area to roost together in the security of these thick bushes on this somewhat open hillside. Incidentally there were pine woods in plenty on both sides and above, the nearest real wood being about three hundred yards distant.

The Red-browed Finch (*Callacanthis burtoni*) is a most intriguing bird. Very little seems to be known of its nesting. In fact the few records extant are somewhat vague. It is by no means an uncommon bird, so how it has succeeded in maintaining its secret is somewhat of a mystery. It certainly breeds around Sonamarg (approximately 9,000 ft.) in May and June. On June 12, I found myself literally face to face with a young bird so uncertain of its wing power that I almost caught it before it fluttered off its perch, while a pair certainly had a nest in the vicinity of some isolated pine trees near the mouth of Glacier Valley. I watched this pair frequently up to June 20, but any amount of searching failed to disclose a nest though just as we were leaving Sonamarg on that date I disturbed them feeding two young ones on the ground near these same pines.

When feeding they are really quite tame. I have often come upon parties feeding on the ground which have only flown up into the nearby bushes or trees, uttering soft 'tews', when I have been right amongst them, and almost before I have got twenty yards away they have commenced dropping down again in ones and twos to the same spot. When disturbed like this, they always seem to fly up onto the nearest eminence, be it a tree or a stump but two feet high, and here they remain sitting quietly until the disturbing element has passed.

Last year I came across an excellent example of the necessity of not allowing enthusiasm to lead one into reporting supposed discoveries without making the most careful investigation into their authenticity. On June 8, I found myself looking into a Monal's (*Lophophorus impejanus*) nest with no less than eight eggs in it. It will be remembered that in *Nests and Eggs*, vol. iii, p. 408, Hume quotes Major Cock who writes of clutches of from five to eight in number. In his *Game Birds*, vol. iii, Stuart Baker discounts these reports, pointing out that recent collectors have never found more than six eggs in a nest and that only rarely. I was recently sent a beautiful photograph of a nest of six eggs by Mr. E. H. N. Lowther. About his nest there is of course no doubt as he found it himself, but my clutch of eight eggs provides a very different story.

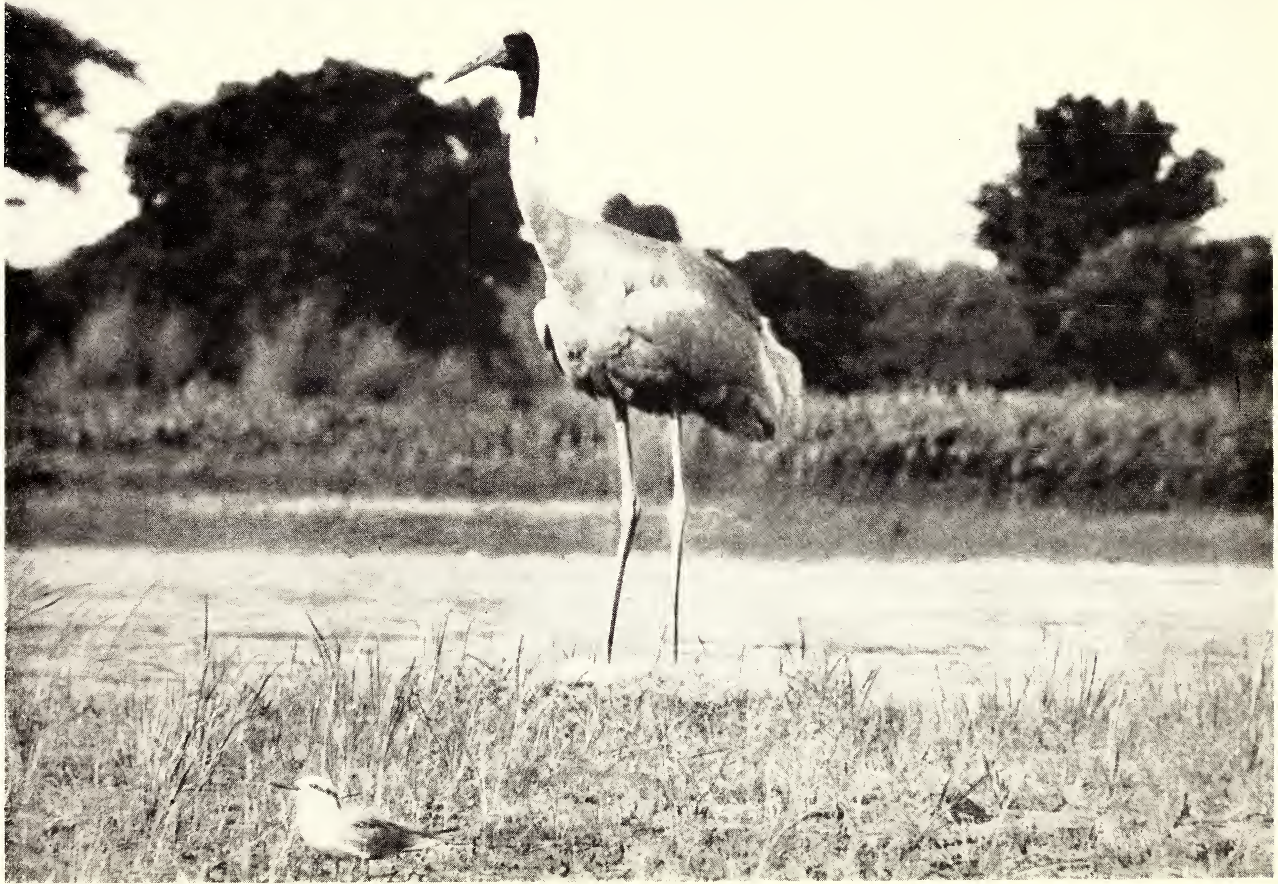
On June 7, I had met a local shikari at a log bridge over the East Lidar a couple of miles above Pahlgam. He wanted me to shoot a bear, but when I said I only shot birds and their nests with a camera, he volunteered the information that he had just seen a Monal on its nest on the steep wooded hillside whence he had obviously come.

I went out with him the very next morning and attempted to photograph the bird on the nest. It was in a hollow under a small fir seedling at the top of some steep rocks by the edge of a log shoot, an impossible place for a hiding tent. All I could do was to rig up the half-plate camera within three feet of the sitting bird. In order to focus I had to lean out over a twenty-foot drop, holding on to the shikari, who in turn was grasping a tree trunk. Having got the focussing done, I then had to clear grass and some dead twigs out of the line of sight. Her Majesty submitted to this turmoil without the flicker of an eyelid, so after quarter of an hour's hard work I thought I would succeed. But pride comes before a fall. An irritating twig, the very last obstacle, was right across her face. An attempt to move it was followed by a whirr of wings and away she sailed down the hillside, swerving shortly into the cover on the left of the shoot.

Of the eight eggs one was very much matted with dirty down. The nest too was by no means clean, containing amongst other debris three large beetles which had evidently been sheltering under her warm breast.

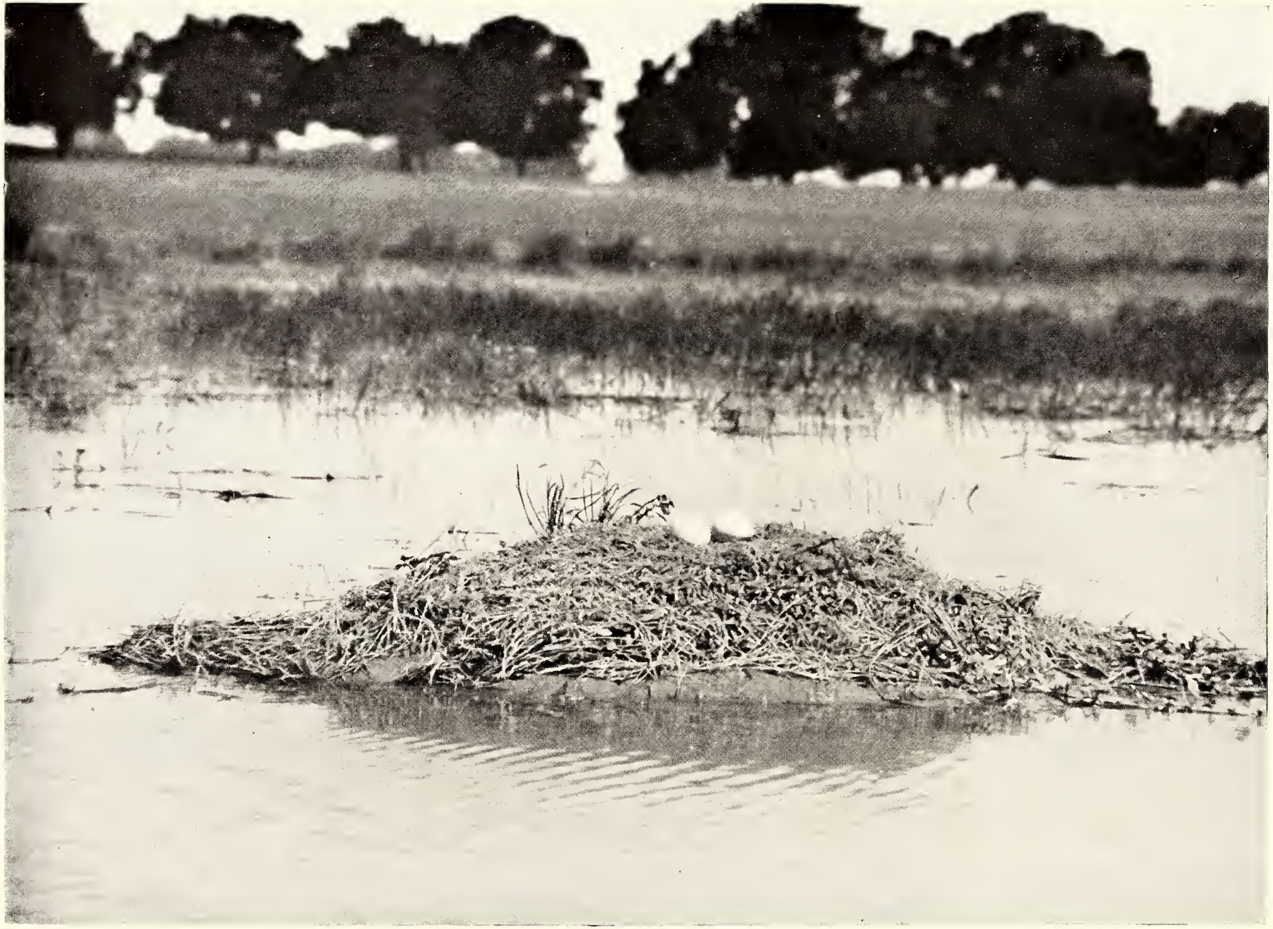
I suggested to the shikari that I should make a further attempt the following day, whereupon he told me that he had received orders to take the eggs and send them down at once under a

PLATE I.



Copyright *R. S. P. Bates.*

Sarus Crane (*Antigone antigone,* Linn.) at nest. Bareilly, United Provinces.



Copyright R. S. P .Bates.

Nest and eggs of the Sarus Crane (*Antigone antigone*, Linn.) near Bareilly, United Provinces.

hen to the authorities in Srinagar where I gathered the young birds would be placed in an aviary.

After due cogitation I felt there was something fishy about this story, as the man was only a local shikari and not one of the official game watchers. On my return to the plains I therefore wrote to the Game Department in Srinagar asking whether, in view of the fact that I was very interested in the discovery of a nest of eight Monal eggs, they would be kind enough to tell me whether the young birds had all hatched out and at what intervals. The reply was enlightening to say the least of it. No instructions whatsoever had been issued regarding this nest. After giving the Department further information, I received a final reply to the effect that the eggs had indeed been sent to Srinagar but to no State Department, implying that the shikari had been indulging in some underhand trading, that the young birds had all died, and that there was good reason to suspect that the eggs were not the product of one hen. The last bit is of course what I had suspected. For his own convenience the shikari had probably put the eggs from a second nest into the one he showed to me.

I have related this story at length to show that it is not safe to trust even one's own eyes in the case of a nest which has been previously found by some worthy who is likely to put personal gain before scientific accuracy. I don't know whether Major Cock employed native collectors (who are so very often unreliable, being more mindful of increased kudos, and bakshish, for discoveries, than of the necessity for the strictest veracity where science is concerned), but this is perhaps the true explanation of these reputed clutches of nine eggs.

In spite of the fact that the Sarus Crane (*Antigone antigone antigone*) is very common around Bareilly in the United Provinces, I found it most difficult to hit upon a nest which promised any chance of successful photography, but in my search for the ideal I remarked many interesting incidents. On August 9 for instance I spent some profitable minutes observing nest building. The pair in question were both hard at it well out in a shallow swamp. One bird remained building up the nest while the other worked round it in a circle, pulling up the reeds and throwing them in the direction of the nest over its left shoulder in one sweeping motion. It worked decidedly fast, averaging round about twenty-five pulls to the minute. I watched them for perhaps twenty minutes. They then broke off and, wandering away together, commenced feeding.

On August 14, not so very far from this same nest, I thought I spotted a Crane's neck protruding above the rice stalks a good half mile from the road I was on. The glasses confirmed my suspicions. As it was obviously a sitting bird I went to investigate. The very moment I left the road the neck disappeared. Fortunately I had marked the place fairly accurately otherwise I might quite easily have missed the nest. She let me walk past her some thirty yards away without moving. Out of the corner of my eye I saw her lying flat in the nest with head and neck laid along the ground straight to her front. It was really most surprising to find how inconspicuous, one might almost say insignificant, this huge bird had become. The nest was merely a circular mound of hardened mud roughly eight feet across, with about half a pound of dried rice-stalks round the edge of the shallow glazed mud central portion containing a single egg. The mound had in all probability been formed from the accumulations of some years of nests.

On August 20, I at last found a nest containing two eggs so placed that the receding waters in the depression in which it had been built had laid bare a patch of mud of sufficiently substantial consistency to enable me to erect the hiding tent at a convenient distance from the nest without fear of coming to a sticky, not to mention a slimy, end. This depression, surrounded on two sides by sugarcane and bordering a weedy tank behind the Sadar bazaar, was usually a rice field, but abnormal rain had filled it up to the very edge of the cane-brakes. Some thirty yards out was a slight hump just under water, a continuation of the muddy spit on which I was eventually on August 26 able to erect the tent. According to my usual practice I put it up late that evening.

In order to have the sun in the right direction and as it was still very hot, I got into the hide at 7 a.m. the next morning. Although there had been no signs of either bird I had only a short time to wait before one of them put in an appearance. Approaching in the usual stately crane manner she stood for a few moments by the nest eyeing the hide, but soon came to the conclusion that it was quite harmless. Mounting the nest, she placed her feet slightly behind the eggs and, lowering her long neck, gently rearranged them with the tip of her bill. She then sank down, ever so slowly—in real cinema slow motion as it were. This action brought her so far back in the nest that it looked as if she would miss the eggs altogether. Naturally she didn't, but they were only just out of sight covered by her breast feathers.

She seemed quite content, sitting with head erect, but within five minutes she stood up, had a good shake, and puffed out all her body feathers until she looked like a thoroughly overgrown powder puff. At this moment a very much moulting Whiskered Tern alighted between the nest and the hide but so close that I had to stop the lens right down to get both birds in focus. Fortunately they had the decency to remain quite motionless while I gave a time exposure. I nearly repeated the performance with a Pheasant-tailed Jacana but it moved out of the field just too soon.

Quarter of an hour after the Sarus had once more composed herself on the nest, I heard a loud trumpet from the direction of Chanehti village. My victim at once took notice, gave forth two terrific blasts in return, and stalked off the nest out of sight to my right. A moment later I heard the powerful beat of her great wings, then all was silence.

For how long was the nest to be left unguarded? I was just wondering when both Saruses walked calmly into view. Alas they were as like as two peas. I had hoped there might be some distinguishing mark by which I could find out whether both or only one parent incubated the eggs, but there was no way whatsoever of telling the one from the other. I have talked all through of the sitting bird as 'she', but perhaps it is quite wrong of me to have done so.

I had at this time another pair under observation but they alas steadfastly refused to nest. One of these was perceptibly smaller than its mate, had a much wider pale band round the neck, and a definitely higher pitched voice.

I took a further number of photographs of both my birds at the nest but the incubation problem remained unsolved. Unfortunately further work at this nest was summarily cut short. The same afternoon heavy rain set in. Next morning the nest was not to be seen—it was a foot or more under water, but wonder of wonders the Sarus was quite calmly incubating one surviving egg, which had been rescued by a villager and placed on a promontory projecting from a canebrake a hundred yards from the late-lamented nest. I never discovered what eventually transpired, but a couple of days afterwards the single egg too had gone, leaving a disconsolate pair of Cranes wandering about the fields of Chanehti.

'AN INTERESTING CASE OF SEMI-CYCLOPIA IN A SHARK.'

BY

JOHN BERRY, M.A. (Cantab.).

From the Natural History Department, University College, (University of St. Andrew's), Dundee.

(*With two plates and one diagram*).

ACKNOWLEDGMENT.

Before dealing with this specimen, I should like first to acknowledge my indebtedness to those who have assisted me with valuable co-operation and help in the examination of the specimen.

Thanks are due, in the first instance, to Mr. C. Boden Kloss, Director of Museums, Straits Settlements and Federated Malay States, for sending the monster together with a normal specimen to University College, Dundee, for investigation. For allowing me to conduct the examination, and for technical advice I am greatly indebted to Professor A. D. Peacock, D.Sc., Natural History Department, and to Dr. G. R. Tudhope, Department of Pathology; also to Mr. A. T. Baxter who prepared the material for microscopical study.

University College, Dundee,
February 1931.

INTRODUCTORY REMARKS.

Obtained by the Raffles Museum, Singapore, from a shark in the local fish-market, this specimen was sent, preserved in formalin, to Professor Peacock at Dundee for examination. It was an example of *Charcharias Dussumieri* (Valenciennes), one of the 'true sharks' all of which are viviparous, and the genus is characterised by absence of spiracles, and dorso-ventral compression of the snout which is not greatly produced longitudinally.

In normal specimens, commencing with the anterior extremity of the rostrum and continuing posteriorly, the ethmoidal rods are more nearly coplanar than in most forms, being also rather shorter and stouter. The chondrocranium is strongly made, having a small anterior fontanelle, and being traversed dorsally by a well-marked longitudinal median depression which serves to mark the separation of the parencephalic lobes; but with other divisions of the brain, these suffered considerable dissectional rupture in preparation of the slides (Plate II, No. 1).

At this stage of development olfactory capsules are large, and olfactory epithelium well developed, since the embryos cannot

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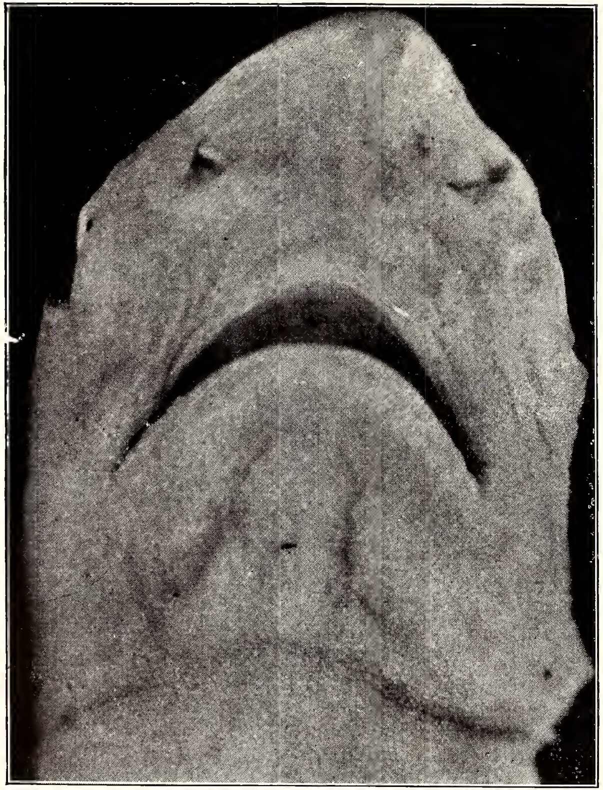
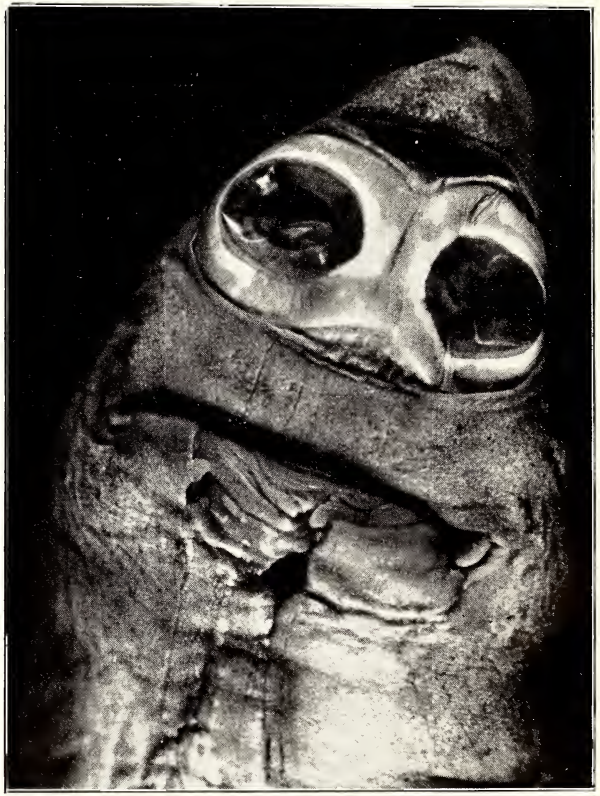
(*Note.*—Although written in 1931, this paper was mislaid and forgotten, hence the delay in publication.—J.B., 1934.)

SEMI-CYCLOPIA IN A SHARK.

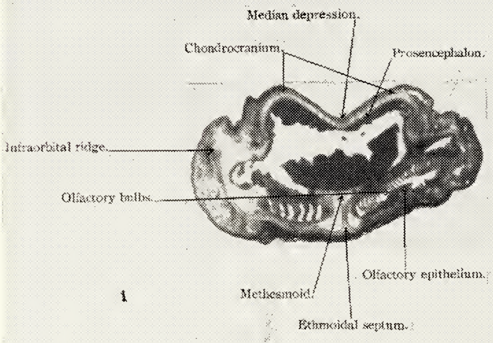


A.—Head of normal shark.



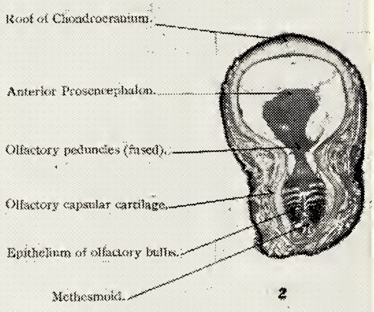
B.—Head of monster.

OLFACTORY REGION—(Normal).


Median depression.
Chondrocranium.
Prosencephalon.
Infraorbital ridge.
Olfactory bulbs.
Olfactory epithelium.
Methesmoid.
Ethmoidal septum.

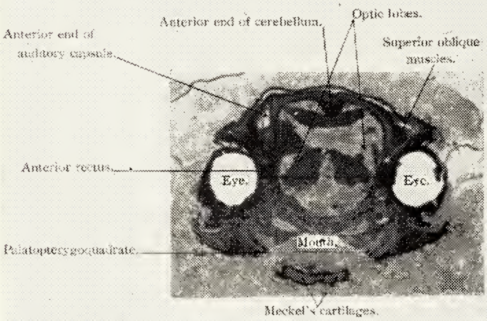
1

OLFACTORY REGION—(Abnormal).


Roof of Chondrocranium.
Anterior Prosencephalon.
Olfactory peduncles (fused).
Olfactory capsular cartilage.
Epithelium of olfactory bulbs.
Methesmoid.

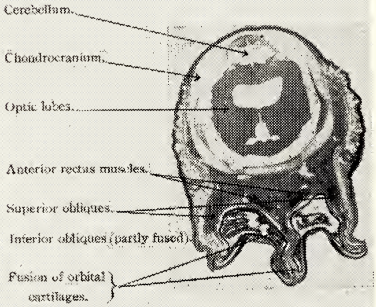
2

INTERORBITAL REGION—(Normal).


Anterior end of cerebellum.
Optic lobes.
Anterior end of auditory capsule.
Superior oblique muscles.
Anterior rectus.
Eye.
Eye.
Palatopterygoquadrate.
Mouth.
Meckel's cartilages.

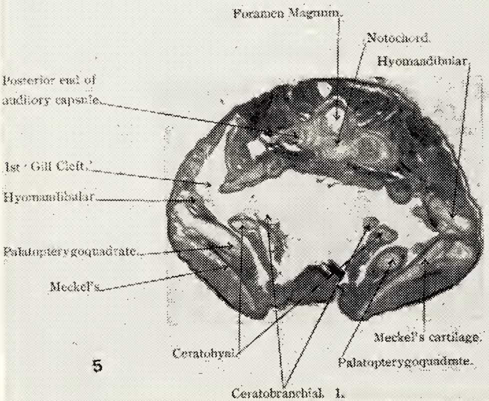
3

ORBITAL REGION—(Abnormal).


Cerebellum.
Chondrocranium.
Optic lobes.
Anterior rectus muscles.
Superior obliques.
Inferior obliques (partly fused).
Fusion of orbital cartilages.

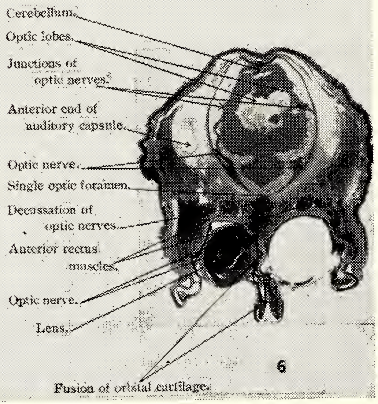
4

OCCIPITAL REGION—(Normal).


Foramen Magnum.
Notochord.
Hyomandibular.
Posterior end of auditory capsule.
1st 'Gill Cleft.'
Hyomandibular.
Palatopterygoquadrate.
Meckel's.
Meckel's cartilage.
Ceratohyal.
Palatopterygoquadrate.
Ceratobranchial 1.

5

INTERORBITAL REGION—(Abnormal).


Cerebellum.
Optic lobes.
Junctions of optic nerves.
Anterior end of auditory capsule.
Optic nerve.
Single optic foramen.
Decussation of optic nerves.
Anterior rectus muscles.
Optic nerve.
Lens.
Fusion of orbital cartilage.

6

SEMI-CYCLOPIA IN A SHARK.

(For explanation see text.)

have been far from birth when their parent was taken. Methesmoid and ethmoidal septum are strong and thick, which is of interest when this region (Pl. II, No. 1) is compared with corresponding parts of the monster (Pl. II, No. 2). Passing backwards towards the interorbital region (Pl. II, No. 3) palatopterygoquadrates are large but devoid of teeth, and the same is also the case with Meckel's cartilages. Unfortunately sections in this region are not as clear as one could wish and the facial nerves were hard to follow; however, in common with the optic nerves and muscles, they are typically elasmobranchian in character and distribution, and detailed description is therefore here superfluous. Auditory capsules are fully developed, and extend in both normal and monster from interorbital to occipital regions. The basihyal is narrow and strongly arched; the first ceratobranchials run upwards and 'overlap' the ceratohyals. Hyomandibulars are short, thick, and articulate at their proximal extremities with the auditory region of the cranium by means of the usual distinct articular facets; but since the monster is from here normally developed, further comparison between the two specimens is uncalled-for.

Abnormalities in the monster appeared to be confined to the anterior portion of the head; posterior to the mouth normality of development was soon evident, and since it was complete from the occipital region, detailed examination was consequently confined almost entirely to the fore and mid brain.

Photographs having first been taken of the monster and a normal specimen of similar age (Plate I), the heads of both were embedded in celloidin and slides prepared from transverse sections 'μ' in thickness, these having been first stained in Delafield's 'haematoxylin', and then counter-stained in Van Gieson's 'picrosaurefuschin'.

Some difficulty was occasioned by contortion of the heads causing apparent asymmetry to appear in the sections, but those selected for reproduction are but slightly affected.

EXTENT AND NATURE OF MALFORMATION IN THE MONSTER.

The rostrum of the monster shows profound malformation. The extremity of the snout consists of a vertical mucilaginous ridge compressed laterally, and immediately under this is a confused mass of cartilage caused by compression of the ethmoidal rods, which in turn are in close approximation to the olfactory capsule.

In the olfactory region (Plate II, No. 2), the head broadens rapidly, but 'depth' still remains considerably greater than 'breadth',—exactly the opposite of the corresponding region in the normal. Olfactory bulbs have undergone complete displacement in a downward direction, lie 'side by side', and even show partial fusion of the olfactory epithelium, especially at the posterior end of the olfactory capsule. Concurrently, methesmoid and ethmoidal septum have been forced downwards to the floor of the olfactory capsule where they form an irregular distorted bar, in places completely fused with the olfactory capsular cartilage. From the olfactory bulbs the olfactory peduncles rise almost vertically, and enter the true brain through the base of the prosencephalon; they are completely fused throughout.

Immediately posterior to the olfactory capsule come the orbits, which—at least externally—are the most striking aberrations which the monster exhibited. Hind, and even mid brains, are fundamentally normal, and although the foramina are unusual in position, the chondrocranium itself is not so far abnormal as to have caused constriction or malformation of any of the chief cranial regions. The orbits are directly ventral to the chondrocranium (Pl. II, No. 4), and so closely have they been compressed by their downward rotation that fusion of orbital cartilages has taken place along what normally would have been their ventral surfaces. In spite of this, however, the 'eye-balls' themselves are quite normal, but as is so often the case, toughness of the lens has caused such severe dissectional rupture that it is seldom possible to recognise all integral portions on the slides. Optic muscles have maintained a normal position relative to the orbits—the anterior rectus being vertically above the 'eye-ball', posterior rectus immediately behind it, and other muscles in equivalent positions on either side. Superior oblique and superior rectus muscles, being now external relative to the others, have undergone no important modifications, but inferior oblique and inferior rectus muscles are largely fused along the greater part of their lengths.

In the cranium, the cerebellum reaches its maximum dilation point slightly anterior to the vertical mid-line through the orbits, and below it the optic lobes, although showing slight downward lateral displacement, are otherwise normal (Pl. II, No. 4). But if the brain be called normal, the same cannot be said of the cranial nerves, and while the majority follow the malformations of the head exactly as would be expected, the optic nerves are so markedly unusual that they seem to call for particular mention.

In the extreme ventral ridge of the chondrocranium there is a single optic foramen (Pl. II, No. 6), and through this the *two* optic nerves—although closely compressed together they maintain their individuality throughout—enter the cranial cavity. There is no optic chiasma in the usual meaning of the term, but decussation of the optic fibres appears to take place at the point of entrance to the cranial cavity in the optic foramen itself. Thereafter the optic nerves run upwards round the inside of the chondrocranium and between that and the brain, to enter the optic lobes mid-laterally.

Posterior to the orbits comes the palatopterygoquadrate bar which has undergone considerable modification as would be expected. This has taken the form of downward, inward and backward compression which transforms these cartilages into a thick transverse block, while a corresponding modification of Meckel's cartilages (*see diagram*) has made of the normally strongly arched mouth practically a straight transverse slit (Plate I, A & B). Directly above the mouth are the auditory capsules which are perfectly normal except for negligible downward and lateral compression.

Visceral arches are all normal, but the basihyal has become

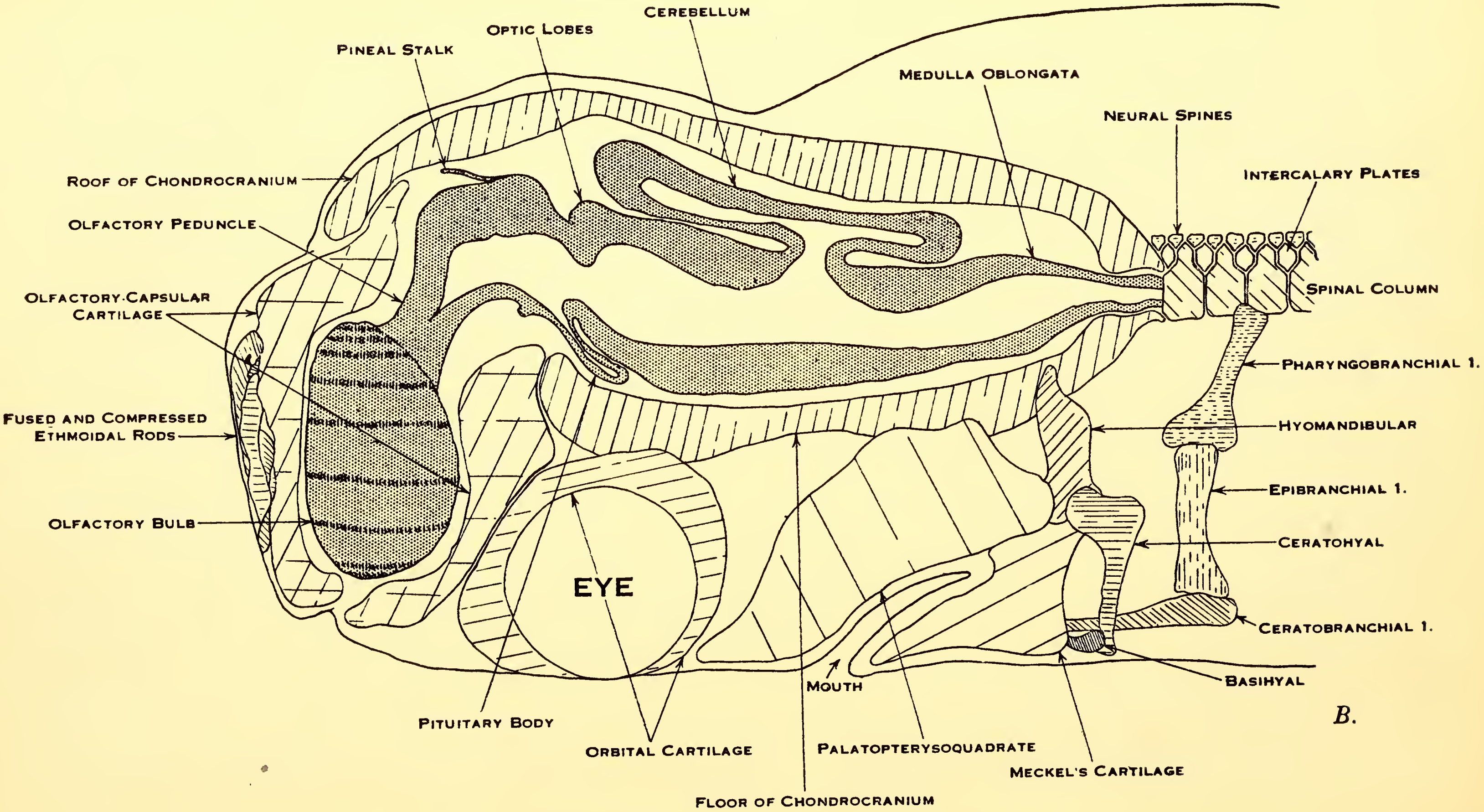

Cerebellum
Optic Lobes
Pineal Stalk
Medulla Oblongata
Neural Spines
Intercalary Plates
Roof of Chondrocranium
Olfactory Peduncle
Spinal Column
Olfactory-Capsular Cartilage
Pharyngobranchial 1.
Fused and Compressed Ethmoidal Rods
Hyomandibular
Epibranchial 1.
Olfactory Bulb
Ceratohyal
EYE
Ceratobranchial 1.
Basihyal
Mouth
Pituitary Body
B.
Orbital Cartilage
Palatopterysoquadrate
Meckel's Cartilage
Floor of Chondrocranium

Diagram to show malformations of the head region.

slightly more flattened transversely than is normal, and the hyomandibular is somewhat curved to conform to alteration in point of articulation of palatopterygoquadrates and Meckel's cartilages. As has already been stated, posterior to the occipital region the monster appears to be entirely normal.

Discussion.

Professor J. F. Gemmill[1] made two postulates in dealing with questions of teratological causation, first, that each recognised type of monstrosity could arise in a spontaneous or autogenetic manner by abrupt germinal variation, and second, that most recognised types could be produced by environmental factors acting during course of development; but he qualified the latter by saying that external factors were only causative in the sense that they could divert a course of development along certain fixed lines of which the limits were strictly governed by those potentialities which allowed for occurrence of the first or autogenetic type of abnormality.

Where monstrosity has arisen from abrupt germinal variation, abnormality of development, if it has not already commenced in the embryonic cranium, has at least become evident at so early a stage that the brain will exhibit the chief germinant irregularities, and to these such associated characteristics as reduction or fusion of optic lenses in cyclopia, for example, are merely secondary. If, however, origin of teratological condition be neither atavistic nor autogenetic, and assuming no pathogenic inception, it is only natural to expect that the brain, which is that portion of the head best shielded to withstand external stresses, will be least affected by mechanical results of adverse environmental conditions.

In the present instance, if consideration be given to the degree of developmental irregularity essential in production of malformations so profoundly and obviously abnormal, it is evident that compared with cranial conditions usually associated with cyclopia and allied monstrosities, the brain, and in fact the whole median and posterior chondrocranium, are singularly unaffected by whatever cause incited teratological aberration of rostrum and orbits.

Compressed and fused ethmoidal rods, together with signs of extreme external pressure on the olfactory capsular cartilage, together with comparative normality of the eye-contents compared to their position and fusion of the sclerotic cartilages, can leave but little doubt that the origin of partial cyclopia in this shark was a purely mechanical effect of adverse environmental conditions during uterine growth.

Although cyclopia is so well-known a type of monstrosity in fishes and other animals, almost all ichthyological examples recorded have been from members of the salmonidae of which embryos are so easily obtained from fish-hatcheries and the like. Besides the present case, only one other example of total or partial cyclopia has been recorded from the elasmobranchii—the historic Eagle Ray

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[1] *The Teratology of Fishes* by J. F. Gemmill; Glasgow, 1912.

(*Myliobatis noctula*—or *aquila*) described by F. Paolucci,[1] and now in the collection of the Technical Institute of Ancona; that specimen had not only been born, but had even survived until the day of its capture by fishermen. It is interesting to note that Myliobatidae, like Charcharidae, are viviparous.

It is possible that the malformation in the present case arose in some such manner as the following: after the embryo had developed normally for some time the outgrowing snout encountered obstruction at two points slightly above, and on either side of the median longitudinal axis, and the rostrum was compressed laterally and depressed downwards. As in the course of embryonic development the fore-part of the head was more and more strongly urged against the obstructions, the frontal extremity and sides became deflected downwards until they met in the mid-ventral line where continued constriction caused partial fusion of various organs.

According to Dr. Gemmill's theory, external pressure would have so upset the normal course of development that latent potentialities of cyclopia would have been given opportunity to assert themselves in formation of a specific and recognised teratological type.

There only remains the question as to whether the embryo could have survived, had it ever been born. In the vast majority of cases, any cyclopic tendency is accompanied by so great a malformation of the jaws, that the embryo is unable to feed; even did condition of the brain not preclude any possibility of survival. From the morphology of this specimen, however, there appears no sufficient reason for stating definitely that the young fish could not have survived. Paolucci's ray had the eye set in the anterior border of the head, which doubtless allowed it a wide range of vision, above, below and on either side. The position of the orbit in this shark would only have permitted of its seeing objects directly beneath it, or nearly so; while this should have been quite sufficient to have allowed it to have obtained its food, it is unlikely that with so limited a range of vision it could for long have escaped its natural enemies.

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[1] *Supra una Forma Monstuosa della 'Myliobatis Noctula'* by F. Paolucci; Atti. d. Soc. It. d. Sc. Nat. 17, fsc. 1; Milano, 1874.

THE MEDICINAL AND POISONOUS PALMS OF INDIA.

BY

J. F. Caius, s.j., f.l.s.

The **Palmae** include about 200 genera with about 1,500 species, natives of tropical and subtropical regions, a few being found in the warmer temperate countries.

The medicinal and poisonous Palms of the world belong to 34 different genera:—Acanthophoenix (Mascarene Islands); Acrocomia (Tropical America; Brazil); Areca (Tropical Asia; Malay-Archipelago; New Guinea; Australia); Arenga (Tropical Asia; Malay-Archipelago; New Guinea; Australia); Astrocaryum (Tropical America); Attalea (Tropical America); Borassus (Tropical Africa; India, from Ceylon to the Sunda Islands); Calamus (Tropical and Sub-tropical Asia; Tropical West Africa; Australia); Caryota (Tropical Asia; Malay-Archipelago; Australia); Chamaerops (Mediterranean region); Cocos (Tropical and Sub-tropical America); Copernicia (America); Corypha (Tropical Asia; Malay-Archipelago); Diplothemium (Brazil); Elaeis (Tropical Africa and America); Euterpe (Tropical America; West Indies); Hyphaene (Africa; India); Licuala (Indo-Malayan region; New Guinea; North Australia); Lodoicea (Seychelles Islands); Loxococcus (Ceylon); Mauritia (Northern Brazil; Guiana; West Indies); Maximiliana (Tropical Brazil; Guiana; Trinidad); Metroxylon (Malay-Archipelago; New Guinea); Nannorhops (India; Afghanistan; Southern Persia); Neodypsis (Madagascar); Nipa (Tropical Asia; New Guinea; Australia); Oenocarpus (Tropical America); Orania (Malay-Archipelago; Papua); Phoenix (Sub-tropical Africa; Tropical Asia); Pinanga (Malay-Archipelago); Raphia (Tropical Africa; Madagascar; Tropical America); Serenoa (Florida, Southern California); Trachycarpus (Northern India; Burma; Northern China; Japan); Wallichia (East India).

The medicinal and poisonous Palms of India belong to 24 genera, either indigenous or introduced:—Acanthophoenix, Areca, Arenga, Attalea, Borassus, Calamus, Caryota, Chamaerops, Cocos, Copernicia, Corypha, Elaeis, Hyphaene, Licuala, Lodoicea, Loxococcus, Metroxylon, Nannorhops, Nipa, Phoenix, Pinanga, Raphia, Trachycarpus, Wallichia.

A. Leaves pinnatisect, leaflets free with reduplicate sides or confluent as a plaited limb. Flowers monoecious or dioecious:—
  1. Male flowers minute, solitary or binate towards the tips of the branches, 3- or 6-androus; female larger, solitary ... ... Areca
  2. Male flower one on each side of a female, stamens 6 or more:—
    a. Leaves unarmed ,... ... ... Pinanga.
    b. Leaves with long spines ... ... Acanthophoenix.
  3. Male flowers 9-12-androus, female petals with valvate tips ,,, ,,, ,,, ... Loxococcus.

4. Male calyx tubular. Stamens 6. Albumen equable Wallichia.
5. Male sepals 3. Stamens many. Albumen equable Arenga.
6. Male sepals 3. Stamens many. Albumen ruminate Caryota.
7. Male flower in catkin-like branches of a drooping androgynous spadix; female capitate at the apex of the spadix ... ... Nipa.

B. Leaves pinnatisect; leaflets with implicate sides. Spadices interfoliar; spathe solitary. Flowers dioecious ... ... Phoenix.

C. Leaves flabelliform, orbicular or cuneiform. Spadices interfoliar; spathes many. Flowers usually bisexual:
1. Fruit with a smooth pericarp. 3 free carpels; each carpel with its own style or stigma:—
  a. Seed curved-reniform; albumen with a single excavation near the raphe ... ... Trachycarpus.
  b. Seed erect elliptic; albumen ruminate ... ... Chamaerops.
2. Fruit with a smooth pericarp. 3 appressed carpels, or carpels united where they meet; stigma one:
  a. Spadix terminal; remains of stigma at the base of the fruit:
    ¶ Style short. Embryo apical ... ... Corypha.
    ¶¶ Style subulate. Embryo dorsal ... ... Nannorhops.
  b. Spadix axillary lateral; remains of stigma apical:
    ¶ Berry drupaceous; endocarp hard brittle. Albumen equable ... ... Licuala.
    ¶¶ Berry with a soft membranous endocarp. Albumen deeply ruminate ... ... Copernicia.

D. Leaves pinnatisect; leaflets with reduplicate sides. Spathes usually many. Fruit clothed with reflexed shining closely imbricating scales:—
1. Stem short, stout, annulated. Leaflets linear with the midrib and edges spinulose. No common spathe, but many small incomplete sheaths ... ... Raphia.
2. Stem elongate. Leaflets acuminate, quite entire, nerves parallel. Spathes tubular, persistent:—
  a. Polycarpic spadices axillary ... ... Calamus.
  b. Monocarpic spadix very large, terminal ... Metroxylon.

E. Leaves flabelliform. Spadices interfoliar; spathes numerous, sheathing. Flowers dioecious; males minute, sunk in the cavities of the catkin-like branches:
1. Stamens 6. Fruit mostly with 3 stones; pericarp thinly fleshy, seeds sinuate ... ... Borassus.
2. Stamens 6. Fruit by the abortion of the carpels, unilocular with one central, woody, ovate stone; pericarp fibrous with a shining epiderm ... ... Hyphaene.
3. Stamens 8. Fruit generally with 1 bilobed kidney-shaped stone. Seeds bilobed ... ... Lodoicea.
4. Fruit large, ovate or oblong, with a dry fibrous outer covering, red or greenish-brown. Seeds usually 3, sometimes 4 or 5 ... ... Attalea.
5. Fruit obovoid, terete or trigonous, 1-seeded ... Cocos.
6. Fruit ovoid or obovoid, 1-3-seeded. Pericarp spongy and oily ... ... Elaeis.

Acanthophoenix.

This genus numbers only four species, natives of the Mascarene Islands where they grow abundantly. Two of them, *A. rubra* with a globose fruit and *A. nobilis* with an oblong-cylindric fruit, are cultivated in some of our Indian gardens.

Acanthophoenix rubra Wendl. (=*Areca rubra* Bory) is a very elegant palm. Its root is a popular diuretic at La Reunion, and the light red decoction is a favourite cooling drink.

French: Palmiste rouge—; *German*: Rote Dornen-Areka.

ARECA.

The genus comprises about 40 species. They are very ornamental and graceful palms inhabiting Tropical Asia, the Malay Archipelago, New Guinea, and Australia.

Only one species, *A. catechu*, is known to be medicinal. Its seed, the betel-nut, is a masticatory of great antiquity with most of the Asiatic races. It is used as an astringent, stimulant and anthelmintic in China, Indo-China, the Malay Archipelago, Australia, Melanesia, Polynesia, the West Indies, Madagascar, La Reunion, and Guiana. It was officinal in the pharmacopoeias of Germany, Sweden, and Switzerland.

Mention must, however, be made of two other species, *A. concinna* and *A. nagensis*, the fruits of which are used as substitutes for the betel-nut.

1. Stamens 6. Fruit 1½-2 in., smooth, orange or scarlet	*A. catechu.*
2. Stamens 6. Fruit 1½ in., umbonate, reddish-yellow .	*A. concinna.*
3. Stamens 3. Fruit 1 in., narrowed at both ends ...	*A. nagensis.*

1. **Areca catechu** Linn. The Betel Nut Palm is cultivated exclusively within the moist tropical tracts that fringe the coast of India, and practically within a belt of land that, with a few exceptions, does not extend inland for more than 200 miles. It rarely ascends to altitudes of 3,000 ft. and gradually disappears, even from the littoral area, as localities are entered where the duration of the dry hot months equals or exceeds the monsoons. It flourishes in the dry plateau of Mysore, Kanara and Malabar. It is usually seen as a garden plant, but occasionally and in certain localities, especially of Western and Southern India, of Ceylon and of Burma, it is grown in special gardens. In Eastern and Northern Bengal, in some portions of Assam and in Ceylon, its cultivation has assumed still greater dimensions.

In some parts of India a decoction of the ROOT is a reputed cure for sore lips.

The root is used in Cambodia for the treatment of liver complaints. It is mixed with numerous other drugs, and made into a decoction to be administered in jaundice.

Malay women use the young green SHOOTS as an abortifacient in early pregnancy.

The dry expanded PETIOLES serve as excellent ready-made splints for fractures.

In some parts of India the juice of the young tender LEAVES mixed with oil is applied as an embrocation in cases of lumbago.

In Cambodia the leaves are considered a good remedy for cough. Mixed with other drugs they are given in bronchitis after maceration in alcohol or vinegar. For lumbago they are reduced to pulp in a mortar and applied hot to the loins.

In Malabar an inebriating lozenge is prepared from the SAP of the tree.

In Malaya the green FRUIT in its unripe state is sometimes used as a poison in combination with opium.

The fact that the use of fresh betel-nuts gives rise to a sensation of strangling and giddiness is well known in the East, and it has also been observed that the nuts of certain trees in most betel plantations retain their poisonous properties when dried. These trees cannot be distinguished from the others, so that not unfrequently accidents happen from their nuts becoming mixed with the produce of the plantation before their presence has been detected. The poisonous properties are destroyed by heat, and consequently many people use the cooked or red betel-nuts of commerce to avoid the possibility of accident. When such nuts have been eaten by mistake, salt or lime juice, or acid pickles are the best remedies.

Yunani practitioners consider the NUT digestive, astringent, diuretic and emmenagogue. They recommend it as a cardiac and nervine tonic; and they use it as an astringent lotion for the eyes.

Hindu medical writers describe the unripe nuts as laxative and carminative; the fresh nuts as intoxicating, productive of giddiness, and harmful to the eyesight; when dried, they are said to sweeten the breath, strengthen the gums, remove bad taste from the mouth, and produce a stimulant and exhilarant effect on the system. Their use is recommended in calculous affections and other urinary disorders, and as an aphrodisiac; for the latter purpose a confection is made by boiling the nuts in milk and adding a number of aromatic and stimulant substances.

The nut is commonly used as an astringent for bleeding gums; in the Punjab, women employ it both internally and locally for stopping discharges from the vagina. In Ceylon it is scraped and applied externally to ulcers.

The seed, reduced to charcoal and powdered, is said to be an excellent dentifrice.

The water in which unripe nuts have been boiled is often given to women along with powdered red betel and other spices after confinement as a gentle stimulant.

The nut is useful in checking the heartburn of pregnancy. Control experiments made with tincture of catechu have shown the superiority of the nut, and would seem to demonstrate that this is not merely due to astringent action; it is quite possible that its property as a nervine stimulant enhances its utility.

In Cambodia the unripe fruit is considered a good remedy for diarrhoea. Five green nuts are heated over a slow fire until they become burning hot inside; they are then cut into slices and, while still hot, made into about a half-pint of infusion to be taken in the course of the day. In cases of dysentery the nut is combined with opium; a pellet of opium about the size of a large grain of maize for every nut. Seven incisions are made obliquely on the surface of the nut and they are filled with opium. The nut is then warmed over a very slow fire and whenever the opium swells it is forced back into the cuts until the whole mass has sunk into the flesh of the fruit. The cooking operation over, the nut is cut into slices and thrown in a pint of water. The whole is then boiled down to one third, and this is to be taken in the course of the day.

Concerning the immature fruit Koman writes: 'On the suggestion of a patient who informed me that he was cured of his consumption by a preliminary administration of the fresh juice of tender arecanuts followed by a prolonged use of pellitory, this drug was given to eight patients. The dose suggested was five ounces of the juice to be gradually sipped in the morning in the course of an hour or two. None of the patients could stand this dose, as it produced violent vomiting and purging. The dose was consequently reduced to half an ounce. Even half an ounce had a nauseating effect and generally produced two or three evacuations. I cannot understand why this preliminary treatment by this special method of purgation is considered necessary. As stated above the juice of the tender nuts acts in small doses as a laxative.'

In Travancore the nuts are variously prepared for use. Those that are used by families of rank are collected while the fruit is tender; the husks or the outer pod is removed; the kernel, a round fleshy mass, is boiled in water; in the first boiling of the nut, when properly done, the water becomes red, thick and starch-like, and this is afterwards evaporated into a substance like catechu. The boiled nuts being now removed, sliced and dried, the catechu-like substance is rubbed to the same and dried again in the sun, when they become of a shining black, ready for use. Whole nuts, without being sliced, are also prepared in the same form for use among the higher classes, while ripe nuts as well as young nuts in a raw state are used by all classes of people generally; and ripe nuts preserved in water with the pod are also used.

In Mysore the nuts are taken as they come from the tree, and boiled for some hours in an iron vessel. They are then taken out, and the remaining water is inspissated by continual boiling. This process furnishes *Kossa*, or most astringent *terra japonica*, which is black, and mixed with paddy-husks and other impurities. After the nuts are dried they are put into a fresh quantity of water and boiled again, and this water being inspissated like the former, yields the best or dearest kind of catechu, called *coony*. It is yellowish brown, has an earthy fracture, and is free from the admixture of foreign bodies.

In the north of China, small pieces of the nut are boiled and the decoction is taken as a domestic remedy in various visceral affections.

The powdered nut, in doses of ten or fifteen grains every three or four hours, has been used with satisfactory results in the relaxed condition of the bowels which sometimes occurs in tropical climates. Large doses, six drachms to one ounce, however, produce griping and irritation; and loose motions may start as a result of such irritation.

In some parts of China the nuts, bruised and powdered, are mixed with the green food given to horses, and they are thus considered a preventive against diarrhoea.

In Europe betel-nuts have been used as an anthelmintic for tapeworm and as an astringent; and in veterinary practice their reputation as a vermifuge is well established.

In India and China the powdered nut is generally given for the expulsion of tapeworm in the dose of 4 to 6 drachms, taken in milk. It is said to be efficacious against round as well as tapeworms. Powell thought so highly of its anthelmintic properties that he expressed the opinion that the habit of chewing arecanut among the inhabitants of certain countries where intestinal parasites are common, is a protective habit instinctively acquired on account of its prophylactic value against these parasites. Waring, however, declared that the nut 'can hardly have any claim to this character, as amongst the Hindu and Burmese, who use it habitually as a masticatory, intestinal worms (lumbrici) are almost universally met with'.

Bentley (1904) and Schueffner (1912) treated a number of cases of hookworm disease with half to one ounce doses of the powdered nuts with little effect. Caius and Mhaskar (1924) gave four drachms of the recently-dried seeds in the form of a powder without any preliminary preparation and without any after purgative in cases of roundworm and hookworm infections. The patients passed one to three semi-solid stools, but no worms were expelled. The powdered fresh nut produced a stronger irritant effect on the intestine, but no worms were expelled. Chopra and Chandler (1928) believe that the chewing of betel-nut and betel-leaf does influence the number of hookworms harboured. This result is not, however, attributable to any anthelmintic power of the juice, which is not swallowed; but to the constant spitting which tends to eliminate the immature hookworms while making their way from the trachea to the oesophagus. The chewing of tobacco has a similar effect, and in some places is credited with anthelmintic power.

Sushruta recommends arecanut as an antidote to snake and scorpion venoms. By injecting cobra venom into dogs and scorpion venom into mice Mhaskar and Caius (1931, 1932) have shown experimentally that the nut has no preventive, antidotal, or therapeutic value.

The seeds were first examined by Bombelon (1886) and later by Jhans (1888-1891), who isolated, in addition to choline, the four alkaloids arecoline, arecaidine, arecaine, and guvacine, of which arecaine is now known to be identical with arecaidine. Emde (1915) added to these arecolidine, and K. Hess (1918) guvacoline.

Of these alkaloids arecoline alone exhibits markedly toxic properties. It belongs to the nicotine-pilocarpine group and acts on the central and peripheral nervous system producing paralysis, which may be preceded by convulsions. With nicotine the central and with pilocarpine the peripheral action is more marked, whilst both are about equal in arecoline. Arecoline hydrobromide is recognised in the pharmacopoeias of France, Germany, Hungary, Russia, Spain, Sweden, Switzerland and Turkey; it is used internally in small doses as a sialogogue and diaphoretic, and as an anthelmintic. It has also been employed like physostigmine to produce contraction of the pupil.

Amboina: Buah, Puah—; *Andamans*: Ahbuddah, Ahpurruddah—; *Annam*: Cay cau, Cay cau gia—; *Arabic*: Fofal, Fufal—; *Assam*: Tambul—; *Banda*: Pua—; *Bengal*: Gua, Supari—; *Burma*: Kun, Kunsi, Kuntheebin, Kwamtheebeng—; *Cagayan*: Bua—; *Cambodia*: Dom sla, Sla—; *Canarese*: Adake, Adaki, Adike, Betta, Bettadike, Bette, Chikaniyadike, Chikke, Cotadike, Kaungu, Khhapura, Poga, Puga, Pugiphala, Tambula—; *Caniarines*: Banga—; *Cantonese*: Pan Long—; *Chinese*: Ping Lang—; *Deccan*: Supari, Supyari—; *Dutch*: Arecapalmboom, Pinang—; *English*: Areca Nut Palm, Areca Palm, Betel Nut Palm, Betel Nut Tree, Betel Palm, Cashoo Nut Tree, Catechu Palm, Catechu Tree, Drunken Date Tree, Fasel Nut, Fauselnut Tree, Medicinal Cabbage Tree, Indian Nut Tree, Pinang Palm, Supari Palm—; *French*: Arec, Arec bétel, Arec cachou, Arec de l'Inde, Arèque, Aréquier, Pinangue—; *French Guiana*: Arec—; *German*: Arecapalme, Arikapalme, Betelnusspalme, Betelpalme, Catechupalme, Katechupalme, Kaupalme, Pinangpalme—; *Guam*: Pugua—; *Gujerati*: Hopari, Phophal, Sopari—; *Hindi*: Supari, Suppari, Supyari—; *Ilocano*: Boa—; *Italian*: Areca—; *Java*: Bhunghanapenang, Jambe, Jebug—; *Konkani*: Fufal, Maddi, Supari—; *Laos*: Kok mak—; *La Reunion*: Arec, Pak—; *Malay*: Pinang—; *Malaya*: Chiniping—; *Malayalam*: Atekka, Chempalukka, Chhonta, Kalunnu, Kamuka, Kavunnu, Kazhangu, Khhapuram, Kramukam, Pakka, Pugam—; *Marathi*: Pophali, Pung, Supari—; *Mundari*: Kasailidaru—; *New Britain*: Bue—; *Pampangan*: Luyos—; *Pelew Islands*: Bua—; *Persian*: Girdchob, Popal, Pupal—; *Philippines*: Bongapalo, Bongasantol, Lugos, Mangupod—; *Porebunder*: Hopari—; *Portuguese*: Areca, Arequeira—; *Russian*: Areka, Kapustnaya palma—; *Sanskrit*: Akota, Chhataphala, Chikkana, Dirghapadapa, Dridhavalkala, Ghonta, Gopadala, Guvaka, Kapitana, Karamatta, Khapura, Kramuka, Puga, Pugi, Rajatala, Suranjana, Tambula, Tantusara, Valkataru—; *Santali*: Gua—; *Sinhalese*: Puvakka, Puwak—; *Solomon Islands*: Boa—; *Spanish*: Arequiero—; *Swedish*: Areka—; *Tagalog*: Bonga, Bongangmatulis, Bunga, Mangipod, Sacsic—; *Tamil*: Kamugu, Kandi, Kiramugam, Kugagam, Pakku, Pakkuppanai, Pugam, Tuvarkkay—; *Telugu*: Chikinamu, Chikini, Gautupoka, Khapuramu, Kolapoka, Kramukamu, Oppulu, Oppuvakkulu, Poka, Prakka, Pugamu, Vakka—; *Tulu*: Kangu—; *Urdu*: Supari—; *Uriya*: Gua, Pugo, Supari, Trinodrumo—; *Visayan*: Bonga—.

2. **Areca concinna** Thw. is endemic in Ceylon and is to be found in the forests of the moist low country; Subarayamuwa, Reigam Korale, Pasdun Korale. It is known as *Len-teri*. It is occasionally planted; the fruits, however, which are also chewed with betel, like those of *A. catechu*, are generally obtained from wild trees.

3. **Areca nagensis** Griff. is found in the Naga Hills, up to 800 ft., very scarce, usually on high situations on river sides. The Nagas and Abors use its fruit as a substitute for the betel-nut.

Naga: Talpat—; *Singpho*: Tongtau—.

ARENGA.

This genus comprises about 10 species of tall, stout palms, distributed throughout Tropical Asia, the Malay Archipelago, New Guinea, and Australia.

A. Engleri Becc. and *A. saccharifera* Labill. are used medicinally by the Chinese.

A. obtusifolia Mart. and *A. saccharifera* Labill. are used as poisons by the Malays. They are both cultivated in India.

1. Leaflets bifarious ... ... *A. obtusifolia.*
2. Leaflets 4-5-fariously fascicled ... ... *A. saccharifera.*

1. **Arenga obtusifolia** Mart. (=*A. Westerhoutii* Griff.) is a native of the Malay Peninsula—Naning, Penang—cultivated in India.

The ripe fruit is an irritant to the mucous membranes. It causes an acute swelling of the mouth and fauces when taken internally, and this is probably due to the mechanical irritation of needle crystals. The juice obtained from it is used by the Malays to poison their enemies. The pulpy part of the fruit is boiled and crushed; and the juice, after straining, is administered in coffee. It is said to cause dyspnoea and restlessness. In the Philippine Islands it is used by the Tagals for poisoning fish.

Malacca: Anooee Kutaree—; *Penang*: Langkab, Langcap—.

2. **Arenga saccharifera** Labill. Sago Palm (=*Saguerus rumphii* Roxb.=*Borassus gomutus* Lour.) is a beautiful and magnificent palm found in Assam, Martaban and Tenasserim, occasionally on the Pegu Yoma; commonly cultivated in India. It is distributed throughout the Malay Peninsula and Archipelago, and ascends in Java up to 4,000 ft.

In Cambodia the root is considered stomachic and pectoral. It is said to be very serviceable in bronchitis marked with profuse expectoration.

The petioles are credited in Cambodia with diuretic and antithermic properties. They are prescribed in chronic paludism with enlargement of the spleen.

The juice of the fleshy outer covering of the fruit is highly stimulating and corrosive. If applied to the skin it causes great pain and inflammation. It is said that the inhabitants of the Moluccas were in the habit of using in the defence of posts during the war a liquor obtained by the maceration of this fruit, which the Dutch appropriately called 'hell-water'. It is used by the Malays to poison their enemies. The pulpy part of the fruit is boiled and crushed, and the juice, after straining, is given in coffee.

Burma: Taungong, Toungong—; *Cambodia*: Thnotnhi—; *Chinese*: So Mu Mien—; *Dutch*: Aren, Arenboom, Sreng, Arengboom, Arengpalm, Arenpalm, Gamoetoeboom, Gomoetipalm, Gomoetoepalm, Sagoeweerpalm, Sagueerboom, Sagueerpalm, Saguweerpalm, Suikerboom—; *English*: Areng Palm, Gomuti Palm, Malay Sago Palm, Sago Palm, Sugar Palm—; *French*: Anou, Arbre au sagou, Aren à sucre, Areng, Gomonto, Gomuti, Lantar, Lontar, Palmier areng, Palmier rondier, Palmier à sucre, Rondier—; *German*: Echte Zuckerpalme, Gomutipalme, Sagwirepalme, Zuckerpalme—; *Ilocano*: Ratipan—; *Java*: Aren, Buwah atap, Duk, Kolang Kaling, Lirang—; *Madura Island*: Dhuk, Edhuk—; *Malacca*: Gumuti—; *Malay*: Anan, Berkat, Kabong—; *Pangasinan*: Anibung—; *Philippines*: Baru—; *Sunda Islands*: Kawung—; *Tagalog*: Cauon, Iroc, Pugahan—; *Tamil*: Kichilippanai, Kumudippanai, Segovarisi—; *Visayan*: Bahi, Hibioc, Hidioc, Ibioc, Idioc—.

ATTALEA.

The genus is Tropical American. It consists of about 23 species distributed in various parts of South America, especially in the vicinity of the Amazon and its tributaries, from the level of the sea to a height of 4,000 ft. above it.

Attalea speciosa Mart. is the *Uanassu* Palm of Brazil and Guiana, cultivated in India. The oil from the fruit is much used in Guiana in the treatment of rheumatic pains.

BORASSUS.

Martelli (1913) has proved conclusively that there are at least 7 species belonging to this genus. They inhabit Tropical Africa, India, from Ceylon to the Sunda Islands, and Northern Australia.

B. flabellifer var. *aethiopum* Warb. is used medicinally in the Gold Coast.

Borassus flabellifer Linn. The Palmyra Palm is a native of India. It extends in North-West India as far north as Aligarh and Shahjehanpur. Isolated trees in gardens are found in Rohilkhand and the Upper Ganges Doab, as far as Saharanpur. Also on both sides of the Persian Gulf, attaining there about the same latitude as in North-West India. Immense groves of it are found on the Malabar Coast, extending from Cape Comorin through Travancore, Calicut, Goa, and the Bombay Presidency, on through Gujerat and, some distance up, on the banks of the Indus. But what are emphatically called the Palmyra regions may be included in a line extending along the Coromandel coast from Cape Comorin to Madras, including the northern portion of Ceylon, and from Madras all along, taking in a considerable belt of the coast between that and Point Palmyras, and then passing up to Gaya. After that the line should be carried on about due east until it reaches Ava, below which, on the banks of the Irrawaddy, there are immense groves of this palm.

The Palmyra Palm is found in various parts of the mountain district of Ceylon, including the vicinity of Kandy and Badulla at elevations of 1,680 and 2,450 ft., respectively, having a mean annual temperature of 74° at the former and 72° at the latter.

Although immense groves are found on the banks of the Irrawaddy, from the sea coast up to nearly as far as Ava or Amarapura in Burma, and as far inland as Gaya in Bengal, and in isolated patches all round and through Ceylon, still the most congenial places for the favourable development of the Palmyra Palm will be found in low sandy plains scarcely elevated above the level of the sea, and where they are exposed to the burning sun, and the force of at least one of the monsoons. Such are Jaffna, with the surrounding islands, and other portions of the Northern Province of Ceylon, the District of Tinnevelly, with portions of the Madura Collectorate, and portions of the Madras and Bombay Presidencies.

The therapeutic properties of the various parts of the Palmyra are described in detail in Sanskrit and Persian medical works. They may easily be gathered from the following records of popular therapy.

The ROOT is considered cooling and restorative. The expressed juice of the young root is used in cases of gastric catarrh and to check hiccup.

In Cambodia the root is said to be a good diuretic and anthelmintic; it is much employed as a cure for gonorrhoea. In Guinea the young roots are boiled in water and the decoction is given in diseases of the respiratory tract.

The decoction of the BARK, with a little salt added to it, is a good astringent gargle for strengthening the gums and the teeth.

Reduced to charcoal and pulverised, the bark makes a good dentifrice.

In some parts of Southern India an extract of the green LEAVES is used internally in secondary syphilis.

The light-brown cotton-like substance from the outside of the base of the leaves is employed in Ceylon as a styptic for arresting haemorrhage from superficial wounds.

The ash of the SPATHE is an antacid in heartburn. It acts as a powerful blister, and is applied on enlarged liver and spleen in combination with some other demulcents.

In Cambodia the SPADIX is considered anthelmintic, diuretic, and antithermic. It is useful in abdominal troubles complicated with swelling and fever, more especially in chronic malarial poisoning with enlargement of the spleen.

The ash of the spadix is given internally in bilious affections, and is largely used as an antiperiodic in many parts of India.

The fresh juice of the plant or TODDY is cooling, sweet and useful in inflammatory dropsy, and gastric catarrh. It acts as a laxative when taken regularly for several mornings. It is helpful in checking hiccup. It is a good diuretic in gonorrhoea, and a good tonic in emaciation or phthisis. It is used as an adjunct to stimulating drugs in the low stages of intermittent and remittent fevers.

The juice is used as a stimulant and antiphlegmatic. A useful stimulant application, called toddy-poultice, is prepared by adding fresh-drawn toddy to rice-flour till it has the consistence of a soft poultice, and this being subjected to a gentle fire, fermentation takes place. This, spread on a cloth and applied to the parts affected, acts as a valuable application to gangrenous ulcerations, carbuncles, and indolent ulcers.

The fermented juice is intoxicating. Slightly fermented it is prescribed in diabetes. The Ayurvedists of Southern India prescribe it also in consumptive cases.

The pulp of the ripe FRUIT is applied externally in skin diseases. The kernel is bruised and applied to the sting of scorpions; but, Caius and Mhaskar have shown experimentally that this has no preventive, antidotal or therapeutic value.

The gelatinous contents of the unripe SEEDS is considered cooling and restorative. It is used as a remedy for nausea and vomiting.

The embryo of the germinating seed is said to be cooling, nutritive and diuretic.

In Cambodia the YOUNG PLANT is given in gonorrhoea and is, moreover, considered antibilious and antidysenteric.

The TERMINAL BUD of the tree is credited with the same therapeutic properties as the embryo of the germinating seed, and is considered cooling, nutritive, and diuretic.

Palm SUGAR is antibilious and alterative; it is used in hepatic disorders and gleet. Candy is given in coughs and pulmonary affections.

The sugar from the Palmyra Palm is considered a valuable antidote in Cambodia. The Khmers say it is a specific for *Strychnos* poisoning.

Bengal: Tal, Talgachh—; *Burma*: Tan—; *Cambodia*: Thnot chhmoul—; *Canarese*: Karitale, Ole, Oleya, Pane, Tala, Tale, Tali, Trinaraja—; *Ceylon*: Pannamaram—; *Deccan*: Taarkdizaar—; *Dutch*: Jagerboom, Weingeevende palmboom—; *English*: Brab Tree, Char Palm, Desert Palm, Fan Palm. Palmyra Palm—; *French*: Cocotier de mer, Rondier, Rondier éventail—; *Fulah*: Doubé—; *German*: Palmyrapalme—; *Gujerati*: Tad—; *Hindi*: Tal, Tar, Tarkajhar—; *Koukani*: Tadmadd—; *Malayalam*: Ampana, Eta, Karimpana, Pana, Talam, Trinarajan—; *Malinke*: Cébé—; *Marathi*: Tad, Tamar—; *Porebunder*: Mototad—; *Portuguese*: Palmeira macha brava—; *Sanskrit*: Asavadru, Bhumipishacha, Chirayu, Dhvajadruma, Dirghadru, Dirghapadapa, Dirghaskanda, Dirghataru, Drumashreshtha, Drumeshvara, Guchhapatra, Karapatravan, Lekhyapatra, Madadhya, Madhurasa, Mahonnata, Patri, Shataparva, Tala, Taladruma, Tamsi, Tantugarbha, Tantuniryasa, Taruraja—; *Sinhalese*: Tal, Talgaha—; *Soussou*: Kanké—; *Tamil*: Anbanai, Edagam, Karadalam, Karambanai, Nilam, Nungu, Panai, Pondai, Pondu, Pul, Purbadi, Puttrani, Sattruppanai, Talai, Talam, Tali—; *Telugu*: Karatalamu, Namatadu, Pentitadu, Potutadu, Tadu, Trinarajamu—; *Tulu*: Ole, Tari—; *Urdu*: Tad—; *Uriya*: Talo, Tanlo, Trinorajo—.

CALAMUS.

This genus numbers over 200 species inhabiting tropical and sub-tropical Asia, Malaya, the Philippine Islands, New Guinea, and Australia; a few are met with in tropical Africa.

C. margaritae Hce. is used medicinally in China; *C. rotang* Linn. and *C. verus* Lour. in Annam and Cambodia.

C. verus also enters into the composition of poisons prepared by the Malays for arrows and blowpipe darts.

The resin from *C. draco* Willd. is officinal in Portugal.

Three out of the 52 Indian species are credited with medicinal properties.

1.	Leaflets many, equidistant, linear uniform	*C. rotang.*
2.	Leaflets in distant opposite groups of 3-5	*C. travancoricus.*
3.	Leaflets in very distant groups of 3	*C. rheedei.*

1. **Calamus rotang** Linn. The Rattan is distributed over the Central Provinces, the Deccan, the Carnatic, and Ceylon; not in Bengal.

The root in combination with other drugs is prescribed for snake-bite in Bhavaprakasha, Rasaratnakara, Yogaratnakara, and Sharangdhar-samhita. It is also prescribed for scorpion-sting in Rasaratnakara, and Vaidyavinoda. Mhaskar and Caius have, however, proved conclusively that the drug either single or in combination does not in any way counteract the poisoning effects of either snake or scorpion venom.

The root is much used medicinally in Cambodia where it is credited with antidysenteric, antibilious, hypotensive, tonic, febrifuge, and depurative properties. In veterinary practice it is employed as a tonic and aperient.

The wood is given as a vermifuge in Annam.

Annam: Cay may—; *Bengal*: Bet, Beta, Chachibet—; *Bombay*: Bet—; *Cambodia*: Lompeak, Rompeak—; *Canarese*: Betta, Habbe, Nagabetta—; *Central Provinces*: Prabba, Pepa—; *Dutch*: Rotting, Rottinggewas, Rottingriet runt, Runtstek, Spaansch riet—; *English*: Cane, Chair-bottom Cane, Common Rattan, Rattan, Rotang, Slender Rattan, Water Rattan—; *French*: Canne de Bengale, Canne épineuse, Canne à main, Jonc de l' Inde, Ratin, Rotang, Rotin, Rottain—; *German*: Palmriet, Rattangpalme, Rotang, Rottang, Rotting, Spanisches Rohr, Steinrottang, Stuhlrohr—; *Gujerati*: Natar—; *Hindi*: Bet, Beta, Chachibet—; *Malay*: Rottamm, Rotan—; *Malayalam*: Chural, Nirvanni, Purampu—;

Marathi: Beta, Veta—; *Persian*: Bed—; *Sanskrit*: Abhrapushpa, Dirghapatraka, Dirghavalli, Gandhapushpa, Kalana, Latavamsa, Manjari namra, Nichula, Ratha, Rathabhra, Shita, Sushena, Vanira, Vanjula, Vetasa, Vetasi, Vetra, Vidula—; *Sinhalese*: Wewel—; *Spanish*: Caña de Bengala, Caña de Indias—; *Tamil*: Arini, Mellisuppirambu, Nirvanji, Pirambu, Pisin, Sadi, Sural, Suvedagandam, Suvedam, Vaniram, Vanjikkodi, Vedasam, Vettiram—; *Telugu*: Bethama, Bettamu, Niruprabba, Pemu, Prabba, Prabili, Sannabettamu—; *Tulu*: Suralbetta—.

2. **Calamus travancoricus** Bedd. is found in the Deccan peninsula: from Malabar to Travancore. The tender leaves are used in dyspepsia, biliousness, and ear troubles; they are considered anthelmintic.

Canarese: Nayibetta—; *Malayalam*: Cheruchural, Kattuchural—.

3. **Calamus rheedei** Griff. grows in Malabar where its powdered dried seed is applied to ulcers.

Malayalam: Kattuchural—.

CARYOTA.

The 12 species which compose this genus are distributed throughout Tropical Asia, Malaya and Australia.

Of the three indigenous species two are used medicinally.

1. Leaves 18-20 ft. long ... ... *C. urens.*
2. Leaves 4-9 ft. long ... ... *C. mitis.*

1. **Caryota urens** Linn. The Fish-tail Palm is found all over India in the forests of the western and eastern moist zones. It is common in Burma, Bengal and Orissa, ascending in Sikkim to 5,000 ft. On the Western Ghats, it extends to near Mahableshwar. It is reported to abound in the south-eastern corner of Aheree in the Chanda District.

According to Ayurvedists the NUT is acrid and cooling; it allays thirst and fatigue.

The nut is used as an application to the head in cases of hemicrania.

A glass of the freshly drawn TODDY, taken early in the morning, acts as a laxative; it is thus much used by the people of Malabar.

Assam: Baraflawar—; *Bombay*: Birlimhad, Birlimhar—; *Burma*: Kimbo, Minbaw, Mimbo—; *Canarese*: Bagani, Baini, Bayne—; *Deccan*: Marikajhar—; *Dutch*: Jagerieboom, Nieboom, Sagueerboom, Wilde Sagueerboom—; *English*: Bastard Sago Palm, East Indian Wine Palm, Elephant's Palm, Fish-tail Palm, Ghaut Palm, Hill Palm, Indian Sago Palm, Jaggery Palm, Kittul Tree, Malabar Sago Palm, Mhar Palm, Toddy Palm, Wine Palm—; *French*: Caryote brûlant, Faux sagonier de l' Inde, Palmier céleri—; *German*: Bastardsagopalme, Ostindische Brennpalme, Sagopalme—; *Gujerati*: Shankrajata, Shivajata—; *Hindi*: Mari, Marikajhad—; *Khond*: Sarta—; *Konkani*: Birlamadd, Birlimad—; *Lepcha*: Runbong, Simong—; *Magahi*: Hlyamban—; *Malayalam*: Anappana, Chundapana, Chuntappana, Irampana, Kalapana, Vainavu—; *Marathi*: Ardhimpari, Ardhisupari, Berli, Berlimad, Berlimada, Berlimhar, Bherawa, Bherlamuda, Bherlimad, Bhirlimahad, Birli, Mad—; *Philippines*: Cabonegro, Sagu, Taguipan; *Porebunder*: Mervajata—; *Portuguese*: Palmeira brava—; *Sanskrit*: Dhoajavriksha, Dirgha, Mada, Madadruma, Madyadru, Madyadruma, Mohakari, Rajju, Vitanaka—; *Saora*: Jivalaggu—; *Sinhalese*: Kittul, Nepora—; *Tagalog*: Pugahan, Taquipan—; *Tamil*: Adam, Irambanai, Kondapanni, Kundarbanai, Pugam, Talam, Thippali, Tippilippanai, Udalarbanai—; *Telugu*: Bakini, Jivalaggu, Kondajivalaggu, Jiluga, Mare, Yatrakatari—; *Tulu*: Indu, Kannida—; *Uriya*: Modhura, Salapo, Solopo—.

2. **Caryota mitis** Lour. This very elegant palm is found in Burma—from Arakan southwards, Martaban, the Malay Peninsula, Penang, the Andaman Islands, and the Malay Archipelago.

In Malaya the FRUIT is put into wells with intent to cause annoyance. Bathing with well-water that has been treated in this way gives rise to an intense itching of the skin, and may cause an acute inflammation of the eyes. The fresh juice of the fruit when applied directly to the skin is extremely irritating.

The juice of the fruit, mixed with bamboo hairs and an extract of toad, is considered a very potent poison in Kelantan.

In Cambodia the soft fibres at the base of the LEAF-SHEATH are used in the cauterisation of wounds.

Cambodia: Anse—; *Malay*: Beredin, Meredin, Tukkus—; *Penang*: Dudur—.

CHAMAEROPS.

The two species of this genus inhabit the western part of the Mediterranean region.

Chamaerops humilis Linn., Dwarf Fan Palm, is the only palm indigenous to Europe. It is found as far up as Nizza in Italy; but thence southwards it has a great range, being met with in all the countries bordering the Mediterranean Sea. It is very common in Algeria.

The fruit is astringent.

Andalusia: Palma—; *Arabic*: Doum—; *Catalan*: Margallo, Margallonera—; *English*: Dwarf Fan-Palm, European Palm—; *French*: Palmier nain, Palmiste—; *Italian*: Cefaglioni, Palma nana, Palmito—; *Maltese*: Giummar—; *Portuguese*: Palma das Vassouras, Palmeira—; *Sicily*: Curina, Giummara, Palmetta, Piumara—; *Spanish*: Palma enana, Palmito—.

COCOS.

The genus consists of about 30 species, all American, one of them cosmopolitan in the tropics.

C. coronata Mart., *C. flexuosa* Mart., *C. nucifera* Linn., *C. schizophylla* Mart., *C. yatai* Mart. are used medicinally in Brazil; *C. nucifera* Linn. is similarly used in India, Indo-China and China.

The fat from the kernel of *C. nucifera* Linn. is officinal in Holland and in Portugal.

Three of the therapeutically active species are to be met with in India.

1. Leaves 1.8-4.5 m. long	*C. nucifera.*
2. Leaves 1.8-2.4 m. long	*C. schizophylla.*
3. Leaves surrect, arcuate; leaflets concinnous ...	*C. yati.*

1. **Cocos nucifera** Linn. The Coconut Palm is found at present in every part of the tropics, where it flourishes in the greatest luxuriance in the vicinity of the sea, especially a few feet above high-water mark. Although that is its chief habitat, it cannot be termed an exclusively littoral plant, for it has been met with far inland—at Merida in Yucatan, at Patna in Bihar, at Concepcion del Pao—. Whenever the Coconut Palm ventures beyond the limits of the tropics, it loses in elegance of aspect and power of productiveness. In the Sandwich Islands, just at the edge of the torrid

zone, it has a mean look, and yields fruit in comparatively small quantities.

The young ROOT is employed as an astringent gargle in sore throat. Boiled with ginger and salt it is efficacious in fevers.

The Ayurvedists credit it with anthelmintic value; but it is rarely, if ever, used as a worm remedy in India. It is popularly known as a diuretic and commonly used as such. It is also prescribed in uterine diseases and in dysentery.

In Cambodia an infusion of the root is considered as a valuable diuretic which is administered in gleet, bronchitis, and liver troubles with or without jaundice.

In Ceylon the root is said to strengthen the gums, and in Tahiti it is occasionally used instead of arecanut by betel-chewers.

In the Gold Coast the BARK is used for curing toothache and earache. Yunani practitioners in India recommend the ash of the bark as a dentifrice and an antiseptic; they prescribe it in scabies.

The TOMENTUM—a soft, downy, light-brown coloured substance found on the outside of the lower part of the leaves, where they spring from the stem—is used for stopping blood in cases of wounds, bruises, leech-bites, etc. It is said to be a good styptic.

The FLOWERS, when used medicinally, are given as an astringent. Sanskrit authors recommended them as useful in the treatment of diabetes, dysentery, leprosy, and urinary discharges, though liable to induce constipation.

If TODDY is drawn early in the morning and drunk at once, it forms a pleasant drink having a slightly stimulating effect and acting as a gentle laxative.

Toddy is refrigerant and diuretic. Its immoderate use causes great harm, resulting in sleepiness, loss of appetite, premature old age, extraordinary obesity, and diseases resembling dropsy and scurvy. Some of those who are addicted to it lose their intellectual faculties, are seized with trembling, or become stupid, absent-minded, or even insane.

Toddy is considered by Europeans as highly unwholesome during the rainy season.

A toddy-poultice is prepared by adding fresh-drawn toddy to rice-flour till the consistence of a soft poultice, subjecting to a gentle fire, and spreading on a cloth. It forms a valuable application to gangrenous ulcerations, indolent ulcers and carbuncles.

The outside scrapings of the HUSK and LEAVES applied to ulcers will cleanse and heal them rapidly if soaked in proof rum.

The husk of the fruit is used in the treatment of tapeworm.

The green FRUIT is given as a refrigerant, and especially employed as an astrigent in the sore-throats of children.

The MILK of the green fruit is a cooling drink, antiemetic and soothing, and useful in allaying urinary irritation. It is a good drink for cholera cases, and it is said to check vomiting when other means fail. If drunk in immoderate quantity the milk of young nuts may produce a slight degree of strangury and a predisposition to dropsical complaints. It is commonly admitted in Bengal that too much cocoanut milk induces a hydrocele swelling of the scrotum. Among the Tahitians the milk is considered as one of the exciting causes of elephantiasis.

In Brazil the milk of immature nuts is applied as a lotion to ulcers of the penis.

The expressed juice of the fresh kernel has been successfully employed in general ill-health, malnutrition, debility, incipient phthisis, thirst, fever and urinary disorders. In large doses it proves aperient, and in some cases actively purgative, on which account it has been suggested as a substitute for castor-oil.

The water of the ripe nut is unwholesome and can be drunk only sparingly, as it is strongly diuretic and is apt to produce an irritation of the bladder and urethra.

In French India the milk is given internally as an antidote for snake venom; but Mhaskar and Caius have proved satisfactorily that it has no such action. Bapat had already noted that two parts of cocoanut milk and 20 parts of sprouts of *Albizzia lebbek* given internally for three consecutive days cure all snake-bites 'with the exception of those of the cobra and the Russell's viper'.

Fresh cocoanut water is the antidote used by Malays to counteract *Sarcolobus* poison.

The fresh kernel or the tender pulp is nourishing, cooling and diuretic. In Ceylon it is given in sunstroke. The ash obtained from its calcination is said to be a valuable antacid and digestive.

The milk and meat of one nut eaten early in the morning, fasting, will expel the tapeworm if present. Caius and Mhaskar found this treatment ineffective in the case of hookworms.

The fresh OIL obtained by boiling the milk of the ripe fruit is used as an application for burns and in baldness. It is thought to have special properties in strengthening the hair, hence it is much in use as a local application in alopecia, and in loss of hair after fevers and debilitating diseases.

In the Konkan the oil which separates from the freshly-rasped kernel, alone or mixed with tamarind-seed oil, is used as an application to burns and rheumatic swellings.

An inunction of the oil to the whole body is used in fevers, and to the chest in lung diseases. In Ceylon the oil is applied to the head for cooling.

The oil is given in plethora and as a vermifuge in Jamaica. An emulsion of the oil and kernel is prescribed in coughs and pulmonary diseases generally.

In the Maldives cocoanut oil is esteemed a powerful antidote against the bite of poisonous reptiles.

The purified and prepared oil is used as a substitute for cod-liver oil in debility and phthisis. Its prolonged use, however, is apt to disturb the digestive organs and induce diarrhoea.

In Germany it is used in pharmacy, to a considerable extent, as a substitute for lard.

The TAR, obtained by covering the thoroughly ignited shell with a stone cup, is a rubefacient and an effectual domestic remedy for ringworm, itch and other parasitic affections.

The old and dried KERNEL is cut into thin slices and used as an aphrodisiac ingredient in confection; also as an anthelmintic, it is given to remove tapeworms.

The terminal bud or CABBAGE is nourishing and digestive. Its fresh juice is cooling and diuretic.

In Cambodia the WOOD enters into the composition of a fumigant prescribed in the treatment of piles.

Ahanta: Kukui—; *Annam*: Cay dua—; *Aowin*: Agye—; *Arabic*: Jadhirdah, Jouzehindi, Narjil, Shajratuljouzehindi, Shajratunnarjil—; *Banziri*: Diko—; *Bengal*: Dab, Narakel, Narikel, Nairyal—; *Betsimisaraka*: Voaniho—; *Bicol*: Niog—; *Bombay*: Maar, Mahad, Mar, Naralchajhada, Narel, Naril, Naural—: *Brazil*: Coco da Bahia, Coqueiro da India, Inajaguasuiba—; *Burma*: On, Ondi, Ong, Onsi, Onti, Ung, Ungbin—; *Cagayan*: Niog—; *Cambodia*: Daung—; *Canarese*: Gitaka, Gitaku, Kobari, Kobbari, Kurube, Matte, Narikela, Narikera, Siyala, Tare, Tenginakayi, Tengu, Trinaraja—; *Chinese*: Yeh Tzu—; *Deccan*: Narel, Narelkajhar—; *Dutch*: Calappusboom, Cocos, Cocosboom, Cocospalm, Kalappus, Klapper, Klapperboom, Klapperpalm, Koko, Kokosboom, Kokosnootenboom, Kokosnootpalm, Kokospalm—; *English*: Cocoa Nut, Cocoanut Palm, Coconut Palm, Cocoanut Tree—; *Ewe*: Yevunai—; *Fanti*: Kube—; *French*: Cocotier, Roi des végétaux, Cocotier commun, Cocotier des Indes, Cocotier nucifère, Cocotier ordinaire, Cocotier porte-noix, Palmier—; *Ga*: Akokoshicho—; *Gabon*: Omangata—; *German*: Calappabaum, Calappusbaum, Cocosnussbaum, Cocospalme, Echte Kokospalme, Indianischer Nussbaum, Kokosbaum, Kokosgalen, Kokospalme, Kokospalmenbaum, Wandernde Seeuferpalme—; *Guam*: Niyog—; *Gujerati*: Naliyer, Nariel, Nariera, Nariyela, Naryal—; *Hausa*: Kwakwar Attagara—; *Hindi*: Narel, Nariel, Nariyal, Nariyalkaper, Nariyel—; *Ilocano*: Niog—; *Italian*: Cocco—; *Java*: Bhungkana, Bhungkananjijor, Enjor, Ijor, Kalapa, Kerambil, Klapa, Klendah, Njejor, Njijor, Njor, Tangkalkalapa, Wiiklapa, Witkrambil—; *Konkani*: Madd—; *Krepi*: Agorne, Naiti, Yevone, Yevune—; *Krobo*: Kokosi, Ngmaicho—; *Malayalam*: Chentennu, Chocham, Karikku, Kulittai, Langalam, Nalikeram, Narikelam, Tenna, Tennu—; *Marathi*: Mad, Mada, Mahad, Mar, Naral, Naralchajhada, Naralmad, Narel, Narela, Narula, Tenginmar, Varala—; *Mundari*: Burkadaru, Narieldaru—; *Mysore*: Nur—; *New Caledonia*: Nou, Nou boibate, Nou bouangae, Nou do, Nou goine, Nou jomalate, Nou kigoute, Nou mia, Nou pougne, Nou tamen, Nou tiguit—; *Nzima*: Kukwe—; *Pahuin*: M'ban n'tang—; *Pampangan*: Ngongot—; *Persian*: Badinj, Darakhtebandinj, Darakhtenargil, Nargil—; *Philippines*: Coco, Lubi, Pangosin, Tapiasin—; *Polynesia*: Niu—; *Portuguese*: Coqueiro, Palmeira—; *Quittah*: Ene—; *Roumanian*: Cocotier—; *Russian*: Kokosovoe dyerevo—; *Sanskrit*: Dakshinatriya, Dridhanira, Dridhaphala, Duraruha, Garikera, Jataphala, Junga, Karakambha, Kaushikaphale. Kurchashekhara, Kurchashirashaka, Langali, Mahaphala, Mangalya, Mriduphala, Mutkuna, Nadikeli, Narikari, Narikela, Nilataru, Payodhara, Phalakeshara, Phalamunda, Putodaka, Rasaphala, Sadaphala, Sadapushpa, Shiraphala, Skandhapal, Skandhataru, Subhanga, Sutanga, Toyagarbha, Trinaraja, Tryakshaphala, Tryambakaphala, Uchhataru, Varaphala, Vishvamitrapriya—; *Sinhalese*: Pol, Polgaha, Polgass, Polnawasi, Tambili—; *Spanish*: Cocotero, Rey de los vegetales—; *Tagalog*: Adiavan, Niog, Pamocol—; *Tamil*: Edagam, Ilangali, Keli, Muppudaikay, Nadigelam, Naligelam, Naligeram, Narigelam, Papparettennai, Talai, Ten, Tengay, Tengu, Tennai—; *Telugu*: Ettabondalakobbari Gujjunarikadamu, Kobbari, Kobbera, Nalikeramu, Narikadamu, Narikelamu, Narikeramu, Langali, Mukkantipandu, Te, Temranu, Tenkaya, Trinarajamu—; *Tulu*: Tare—; *Twi*: Kokosi—; *Urdu*: Nariyel—; *Uriya*: Gotoma, Langoli, Nodia, Paido, Poiu, Trinodrumo—; *Visayan*: Anibong, Bonotan, Botong, Cayomanis, Dahili, Lobi, Lubacan, Niogngapoti, Lobingahinbaon, Lobingapilipog, Limbaon, Niog, Pangonn, Pilipog, Potot, Tamis, Tamisan, Tayomanis—; *Zambales*: Ongot—.

2. **Cocos schizophylla** Mart., Aracuri Palm, is a native of Brazil found in the Province of Bahia at Camamu and Bahia, San Jorge dos Lheos. It is cultivated in Indian gardens.

In the Province of Bahia the juice of the unripe fruit is used for inflammation of the eyes.

Brazil: Alicuri, Aracui, Aricuri, Ariri—; *English*: Aracuri Palm—.

3. **Cocos yatai** Mart. inhabits Argentine—provinces of Concordia, Corrientes and Entre Rios—and Brazil. It is cultivated in Indian gardens.

In Argentine, where it is known as *yatai*, the fleshy parts of the fruit are considered anthelmintic.

COPERNICIA.

The genus numbers 9 species spread over Brazil, Venezuela, Argentine, San Domingo, Cuba and New Granada.

Copernicia cerifera Mart., Brazilian Wax Palm, inhabits Brazil and is found in the Provinces of Bahia, Pernambuco and Piauhy. It is sometimes grown in Indian gardens.

The root is alterative and diuretic, and is in high popular esteem as a tonic and blood purifier.

Brazil: Carnauba—; *English*: Brazilian Wax Palm—.

CORYPHA.

The 6 species of this genus inhabit Tropical Asia.

Corypha umbraculifera Linn. The Talipot Palm is rather common in Ceylon in the moist low region below 2,000 ft. It is also met with on the Malabar Coast and in Kanara—in the moist forests of the Kumpta and Honavar talukas of Northern Kanara, covering extensive areas near the Gersoppa and Yena rivers, also on the Yellapur Ghats; sometimes planted in gardens near the coast. It extends to the South Andaman Islands, the Little Coco and the Great Coco. It is cultivated in tropical India and Burma.

The fruit is a fish poison.

Bengal: Bajarbattuler, Tali, Tallier, Tara, Tarit—; *Burma*: Pebin—; *Canarese*: Baini, Indu, Sritale, Sritali, Tali—; *English*: Fan Palm, Great Fan Palm, Holy Palm, Java Fan Palm, Malabar Coast Fan Palm, South Indian Talipot Palm, Talipot Palm, Umbrella Palm—; *Malayalam*: Kutappana, Sitalam, Talippana—; *Marathi*: Bajarbattu, Tali—; *Sanskrit*: Alpayushi, Karalika, Katakali, Pakti, Sritala, Tali—; *Sinhalese*: Tala—; *Tamil*: Kudaippanai, Sidalam, Talappam, Talippanai—; *Telugu*: Dridhatalamu, Sritalamu—; *Tulu*: Panoli—.

ELAEIS.

The genus numbers 4 species, inhabitants of Tropical Africa and Eastern Tropical South America.

E. guineensis Jacq. is used medicinally in Equatorial West Africa and in Brazil; *E. melanococca* Gaertn. too is used in Brazil.

Elaeis guineensis Jack. The African Oil Palm is a native of Africa, cultivated in India.

In Guinea the oil from the sarcocarp is applied to wounds as a vulnerary. It is used as a liniment for rheumatism and courbature.

The Bubis of the Island of Fernando Po make an excellent poultice of the oil which they apply to wounds.

In Equatorial West Africa the roots are used as a diuretic, and the fresh sap as a laxative.

Angola: Dihoho—; *Bacongo*: Matebbe—; *Baffuru*: M'bila—; *Baga*: M'Bia—; *Banziri*: Bete—; *Brazil*: Coqueiro de Denté—; *Congo*: Leba—; *Dutch*: Afrikaansche awarra, Afrikaansche oliepalm, Obepalm, Oliepalm van Guinea, Oliepalm van West Africa, Oliepalm van de Kust van Guinea, Palmietboom—; *English*: African Oil Palm, Oil Palm, True Oil Palm—; *French*: Aouara d'Afrique, Aouara des Caraïbes, Aoura de Guinée, Aovora, Arouara des Caraïbes, Avoira de Guinée, Elaïs de Guinée, Eléide, Eléide de Guinée, Noix de palme, Noix de palmier, Palmier crocro, Palmier épineux, Palmier à huile, Palmiste épineux—; *Ga*: Ngmetsho—; *Gaboon*: Oila—; *German*: Afrikanische Oelpalme, Guineische Oelpalme, Oelpalme—; *Guinea*: Toehntis—; *Hausa*: Kwakwa—; *Malinke*: Tintulu—; *Nzima*: Arairlair—; *Pahuin*: Aline—; *St. Thomas Island*: Denden, Palmeira andim—; *Surinam*: Aaavora, Avoora, Avouara, Avuara, Maba, Obe—; *Susu*: Tugi—; *Twi*: Abair—; *Yakoma*: Zamba—.

HYPHAENE.

This genus numbers 27 species distributed all over tropical and sub-tropical Africa, Arabia, and Western India.

Hyphaene thebaica Mart. The Egyptian Doum Palm grows along the valley of the Nile in Middle and Upper Egypt, and is to be met with at Shaik Othman near Aden. Old specimens may be seen in many a garden of India and Ceylon, and, as a rule, they are much better developed than the tree growing in Egypt.

The fruit is considered anthelmintic.

Diu Island: Okamundel—; *Egypt*: Mama—; *English*: Egyptian Doum Palm, Gingerbread Tree—; *Ewe*: Sokuti—; *Gold Coast*: Dum Palm, Gingerbread Palm—.

LICUALA.

This genus comprises about 50 species inhabiting Asia, Australia and the Pacific Islands.

Licuala spinosa Wurmb. (=*Corypha pilearia* Lour.) is found in Malacca, common in wet places, particularly in hedges. It is also met with in the tidal forests of the Andamans, in the Nicobars and the Malay Islands.

In Cambodia the bark is used in combination with other drugs for the treatment of tuberculosis with spitting of blood.

Cambodia: Chak—; *Malay*: Plass—.

LODOICEA.

The genus is limited to 1 species endemic in two of the Seychelles Islands: Praslin and Curieuse.

Lodoicea seychellarum Labill., Double Cocoanut Palm.—The marvellous medicinal properties which are ascribed to the NUTS by ancient physicians, both European and Asiatic, have now been recognized as fanciful and due solely to the rarity of the fruit.

The water of the green fruit or its soft kernel is said to be antibilious and antacid when taken after meals. The ripe fruit is also used similarly, but is at the same time purgative.

The kernel is a tonic and stomachic. With rose water it is given in indigestion, diarrhoea, and for the relief of colic. In combination with other drugs it is made into a paste and applied to swollen glands.

In Southern India the kernel is given in woman's milk for the treatment of typhus fever. It is credited with antiscorbutic and antivenereal properties.

In Bombay it is prescribed as a tonic and febrifuge, and is used to check diarrhoea and vomiting, especially in cholera. It is also commonly given to children, mixed with the root of Nux-vomica, for colic.

The nut is in great repute among the Arabs as a tonic, preservative and alexipharmic.

The fibrous HUSK of the nut is used in the form of a decoction in the Tamil country. It is considered useful in reducing the quantity of sugar in the urine in cases of diabetes. Koman (1919) gave the decoction to two patients in the hospital with diabetes mellitus. The sugar eliminated decreased considerably, but did not disappear altogether. There was relapse as soon as the decoction was stopped.

Arabic: Narjilebahri—; *Bombay*: Jaharinaral, Jeharinaryal—; *Burma*: Péule-on-si—; *Deccan*: Daryakanarel—; *Dutch*: Dubbele cocosnoot van de Seychelles, Dubbele Klapper, Maledivische noot, Seychellennoot, Zeeklapper—; *English*: Cocoanut of the Maldives, Double Cocoanut Palm, Sea Cocoanut Palm—; *French*: Coco de l'île Praslin, Coco des Echelles, Coco de mer, Coco de Salomon, Coco des Seychelles, Cocotier des îles Seychelles, Cocotier des Maldives, Cocotier des Seychelles, Cul de négresse, Double Coco, Lodoïce des Maldives, Lodoïcée, Lodoïcée des Seychelles, Lontar domestique, Rendier éventail, Rendier lontar, Tobel—; *German*: Doppelte Cocosnuss, Kokosartige Lodoicée, Maldivische Nuss, Meercocos, Seecocos, Wundernuss Salomons—; *Gujerati*: Daryanunariyal—; *Hindi*: Daryakanaryal—; *Indian Archipelago*: Calappalaut—; *Java*: Djenggi, Djenggli, Kelapalaut, Kepodjenggi, Pelokdjenggi—; *Malayalam*: Akraritennu, Kataltenna—; *Persian*: Nargilebahri—; *Portuguese*: Coco das Maldivas, Coco do Mar—; *Seychelles*: Coquinko, Tavacarre—; *Sinhalese*: Mudupol—; *Tamil*: Kadattengai—; *Telugu*: Samudraputenkaya—.

LOXOCOCCUS.

The genus is limited to 1 species endemic in Ceylon.

Loxococcus rupicola Wendl. and Drude is known in the vernacular as *dotalu*. Its seed is used for mastication with betel, like arecanut.

METROXYLON.

This genus comprises about 9 species, natives of the Malay Archipelago, New Guinea and Fiji.

1. Spikes 4-5 in. long, $\frac{1}{2}$ in. in diameter ... ... *M. sagus.*
2. Spikes $2\frac{1}{2}$ in. long of the size of the little finger ... *M. rumphii.*

1. **Metroxylon sagus** Rottb. (=*Sagus laevis* Rumph.). The common Sago Palm is to be found in the entire group of the Moluccas, and in Borneo, Sumatra, Java, the Philippine Islands, the Malay Peninsula; chiefly cultivated.

The fruit is used as a poison in Malaya.

Dutch: Meeboom, Meelgevende palmboom, Moluksche palmboom, Sagoboom, Sagoeboom, Sagopalm—; *English*: Common Sago Palm, Rumphius's Sago Palm, Sago Palm, Sago Tree—; *French*: Arbre au sagon, Palmier du Japon, Palmier sagon, Sagonier, Sagonier farinifère, Sagoutier—; *German*: Echte Sagopalme, Molukkische Sapfenpalme, Rumph's Sagopalme, Sagobaum, Sagopalme—.

2. **Metroxylon rumphii** Mart. (=*Sagus rumphii* Willd.) is distributed throughout the Malay Archipelago.

The fruit is used as a poison by the Malays.

English: Rumph's Sago Palm—; *Malay*: Sagu—.

NANNORHOPS.

The genus is limited to 1 species distributed through Sind, Baluchistan, Punjab and Afghanistan. It is abundant in the Peshawar Valley, in Kohat and in the trans-Indus territory along the eastern skirts of the Suliman range, ascending up to 3,000 ft. Also very common on the hills which form the western boundary of Sind. It is common locally on a limited area in the central Salt Range, between 2,000 and 5,000 ft. and on Mount Sakesar. In one place in the Siwalik tract east of the Jhelum, near Sumani above Bhimbur. It is common in the Khaiber Pass, and generally in the low arid mountains of eastern Afghanistan. It is found everywhere up to 5,000 ft. in Baluchistan and Makran, except near the coast.

Nannorhops ritchieana H. Wendl. is a low gregarious shrub, the leaves usually tufted from an underground, much-branched rhizome.

The young leaves are given in diarrhoea and dysentery. They are also purgative, but chiefly used in veterinary medicine.

Bangash Hills: Fiesch—; *Barkhan*: Dhora, Mazari—; *Duki*: Dhora, Mazari—; *Hindi*: Mazari, Mazri—; *Jhalawan*: Pish—; *Kohlu*: Dhora, Mazari, Pish—; *Musa Khel*: Dhora, Mazari—; *Pushtu*: Maizurrye—; *Salt Range*: Kaliun, Kilu—; *Shahrig*: Dhora, Mazari, Pish—; *Sibi*: Dhora, Mazari, Pish—; *Sindh*: Dhora, Fease, Pease, Pesh, Pfarra, Phana, Pfis—; *Trans-Indus*: Mazari, Mazrai, Mzarai—.

NIPA.

The genus is limited to 1 species which covers thousands and thousands of acres of the salt marshes of the islands and coasts of the Indian Ocean. It inhabits the river estuaries and tidal forests of the Sunderbans, Chittagong, Burma and the Andamans, and extends throughout Malaya to Queensland. Its Western limit is Ceylon where it is to be found at the mouth of rivers on the south-west coast, Kalutara, Gindura River near Galle.

Nipa fruticans Wurmb. The Nipa Palm is used medicinally in the Philippine Islands.

The fresh leaves are much used in the treatment of ulcers in the form of cataplasm or lotion. They are considered a valuable remedy for the bites of centipedes.

The alcohol obtained from the toddy by distillation is mixed with water and used as an eye wash in inflammations of the eyelids and of the conjunctiva.

Andamans: Poothada—; *Bengal*: Gabna, Gulga—; *Burma*: Dane—; *Cagayan*: Tata—; *English*: Nipa Palm, Water Cocoanut—; *Guam*: Nipa, Sasa—; *Gujerat*: Paradeshitadio—; *Hindi*: Gulga—; *Philippines*: Lasa—; *Ponape*: Parran—; *Sinhalese*: Gimpol—; *Sulu Archipelago*: Ballang—; *Tagalog*: Nipa, Sasa—; *Telugu*: Kotitikaya, Nipamu—; *Zambales*: Saga—.

PHOENIX.

The genus consists of about 12 species which inhabit subtropical Africa and Tropical Asia.

Four of the species are credited with medicinal properties.

1. Leaves 2-6 ft. long	*P. pusilla.*
2. Leaves 8-10 ft. long	*P. paludosa.*
3. Leaves 10-15 ft. long	*P. sylvestris.*
4. Leaves longer	*P. dactylifera.*

1. **Phoenix pusilla** Gaertn. is to be found on the Coromandel Coast, not far from the sea, and in the dry forests of the northern part of Ceylon.

The fresh SAP is cooling and laxative.

The GUM is used in diarrhoea and in genito-urinary diseases.

The FRUIT is prescribed in cough, asthma, fetid breath, also in fever and gonorrhoea.

The SEEDS are made into a paste by trituration with water and applied over the eye in inflammations and for opacity of the cornea.

Canarese: Hullichala, Ichalu, Sannayichalu—; *Ceylon*: Inchu—; *Hindi*: Palawat—; *Malayalam*: Chittintal, Inta—; *Tamil*: Ichu, Indu, Inju, Kalangu, Kurinji, Sagi, Siruyinju, Sittinju—.

2. **Phoenix paludosa** Roxb. The Wild Date Palm is tolerably common throughout India, wild or more often cultivated. It forms siderable portion of the impenetrable woods which cover the Sunderbans. It is met with along the Selwin, between Amherst and Moulmein, and extends to Penang, Siam and Cochin China.

The fruit is acidulous, sweet and cooling. It relieves flatulence and assuages pain. It is given in fever and inflammation.

Bengal: Golpatta, Hintal, Hital—; *Burma*: Thinboung—; *Hindi*: Hintal—; *Penang*: Dangsa—; *Sanskrit*: Hintala—; *Telugu*: Giruka tati, Hintalamu—.

3. **Phoenix sylvestris** Roxb. The Wild Date Palm is tolerably common throughout India, wild or more often cultivated. It forms extensive forests in Rohilkhand, on the low ground along the Ramganga River, and on the plateau of Mysore, between Shimoga and Tumkur, in the moister stretches of low ground which intersect and drain the rocky undulating granite hills. It is most abundant in Bengal, Behar, on the Coromandel Coast and in Gujerat. In the Bombay Presidency it is common in moist ground throughout the dry districts, usually along banks and in the beds of streams and watercourses. It is not uncommon in the Siwalik tract and the outer Himalaya, reaching up to 5,000 ft. in Kumaon. It is met with at Ghiaunla in Garhwal at 3,500 ft., along the banks of the Bias above Mandi, in the Jamu hills at 2,000 ft. elevation, and in the Salt Range.

The ROOT is given for toothache.

The fresh TODDY is considered a cooling drink.

The FRUIT is prescribed in gonorrhoea and gleet.

The fruit, pounded and mixed with almonds, quince seeds, pistachio nuts, spices and sugar forms a very popular restorative remedy.

A paste, formed of the KERNELS and the root of *Achyranthes aspera*, is eaten with betel-leaves as a remedy for ague.

Bengal: Kajar, Kejur—; *Berar*: Seindi—; *Bombay*: Khajur, Khajura, Khajuri, Sendi—; *Canarese*: Andadayichalu, Ichala, Ichale, Ichalu, Ichela, Ichil, Kallichalu, Kallu, Siyindu—; *Deccan*: Sandolekanar—; *English*: Date-sugar Palm, Indian Wine Palm, Sugar Palm, Wild Date Palm—; *Gond*: Sindi—; *Gujerati*: Kajuri, Kharak, Tadi—; *Hindi*: Kejur, Khaji, Khajur, Khajuri, Salma, Sendhi, Thakil, Thalma—; *Kolami*: Khajur—; *Konkani*: Kajuri—; *Malayalam*: Inta, Intappana, Kattinta—; *Marathi*: Boichand, Sendri, Shindi, Sindikajuri—; *Mundari*: Darukita, Kitadaru—; *Porebunder*: Khalelananjhad, Tadi—; *Punjab*: Khaji, Khajur—; *Sanskrit*: Bhumikharjurika, Duraroha, Duraruha, Dushpradarsha, Haluka, Haripriya, Kakakarkati, Kapila, Kashayi, Kharju, Kharjuri, Mriduchhada, Nishreni, Skandhappala, Svadi, Svadumastaka, Yavaneshta—; *Santal*: Khijur—; *Tamil*: Ichambanai, Inju, Karavam, Kattinju, Madal, Periyayinju—; *Telugu*: Ita, Peddayita—; *Uriya*: Khorjuri, Khorjuro—.

4. **Phoenix dactylifera** Linn. The Edible Date Palm is cultivated and self-sown in Sind and in the Southern Punjab, particularly near Multan and Muzaffargarh, also in the Sind Sagar Doab and trans-Indus territory. Near Dehra Ghazi Khan, date-palms are very numerous on a strip 10-12 miles long from north to south. A few trees are found planted at many places in the Eastern Punjab, also at Saharanpur, and here and there in the Ganges Doab and Bandelkhand. It is also grown in the Deccan and Gujerat, but does not thrive in Bengal. It thrives luxuriantly in the arid rainless regions of North Africa and West Asia, where it is exposed to extreme heat in the daytime, and not uncommonly to frost at night, but it requires a certain amount of moisture in the soil. In Europe it is cultivated in Spain, on the Hyères Islands, the Riviera near Nice, San Remo and Genoa, where it attains its northernmost point. There is a wood of date-palms at Bordighera near San Remo, said to contain over 4,000 stems cultivated mainly to yield palms for Palm Sunday at Rome. In South Italy, Sicily and Greece, the tree is not uncommon, but the fruit is small and poor.

The tree yields a GUM which is considered a demulcent, diuretic and refrigerant. It is esteemed in the Punjab as a valuable remedy in diarrhoea and diseases of the genito-urinary system.

When the heart of the LEAVES is cut out a sweet thickish fluid collects in the cavity, which is very refreshing and slightly purgative. Yunani practitioners use the leaf as an aphrodisiac and prescribe it in liver complaints.

The fresh SAP is cooling and laxative.

The FLOWER is bitter. The Mahommedans say it is purgative, expectorant and tonic to the liver; they recommend its use in fever and blood diseases.

The fresh FRUIT is considered demulcent, expectorant, laxative, tonic and diuretic. But a long continued use is said to produce soreness of the gums. Water in which fresh dates have been steeped for a while is given to relieve alcoholic intoxication. Milk in which clean and fresh dates have been infused is a very nourishing and restorative drink especially during convalescence from fevers and small-pox.

Dates are said to promote expectoration, soothe the chest and also prevent constipation. They are prescribed in cases of cough, asthma, consumption and generally for all kinds of chest troubles. They are also given in fever, gonorrhoea, liver complaints and abdominal troubles; and they are recommended for the treatment of dysentery.

The dried fruit, pounded and mixed with almonds, quince seeds, pistachio nuts, spices and sugar, forms a much esteemed restorative. It is also used as an ingredient in various tonic and aphrodisiac preparations.

In Southern India the ground SEEDS are made into a paste by trituration with water and applied over the eyelids for opacity of the cornea. The paste is also said to be efficacious in relieving headaches and hemicrania.

A fine paste made of the seed of the date-fruit and the root of *Achyranthes aspera* is applied to betel-leaves and made into little packets together with clove, cardamom, catechu and arecanut. Three packets are administered at intervals of one hour before an expected attack of ague.

The smoke from the burning powdered seeds affords great relief when used as a fumigant for piles.

Arabic: Nakhleh—; *Badaga*: Gajjira—; *Bengal*: Khajur—; *Bhote*: Khasser—; *Bombay*: Khajur—; *Burma*: Sunbalun, Swonpalwon—; *Canarese*: Kajura, Karika, Karjura, Kharjura—; *Chinese*: Wu Lou Tzu—; *English*: Arabian Date Palm, Cultivated Date Palm, Edible Date, Large Date, Persian Date—; *French*: Dattier, Dattier cultivé—; *German*: Dattelbaum, Dattelpalme—; *Greek*: Phoinix—; *Gujerati*: Karek, Khajur—; *Hebrew*: Chhomer, Tomer—; *Hindi*: Khaji, Khajur—; *Italian*: Dattero, Palma—; *Kachhi*: Khaji—; *Kej*: Abdandan, Abraughan, Amiri, Anguro, Arrasht, Bambai, Banduk, Barni, Barral, Bingu, Bulediraughani, Burshakri, Buzband, Chafshak, Charpan, Dashtari, Gognai, Gozti, Gundgoreg, Gurbagu, Gwazo, Haleni, Husaini, Jafash, Jafshakjalgi, Jamsaki, Jowanabushmas, Johanajaski, Jozo, Kalerak, Kalunti, Karpaso, Khargi, Khurmazard, Kohijalgi, Kuleri, Kuzanabat, Mairisurkh, Makli, Mataftaza, Mulkijalgi, Nazamdazi, Nazantabaqi, Nazbibilanguk, Naznin, Pandi, Peshnai, Pingu, Pull, Ragom, Baughani, Santgwaragh, Shagashkhand, Shipga, Siahkanok, Sohri, Suhrebegamjangi, Tigal, Ushtarkor, Wakhshi, Wasbkalunt, Washkung, Washnao, Zard—; *Kohhaja*: Mach—; *Malayalam*: Itta, Ittappalam, Tenitta—; *Malta*: Palma, Palma da datteri, Palma tattamar—; *Marathi*: Kharjur—; *Nasirabad*: Khajji, Khurma—; *Nushki*: Mach—; *Panjgur*: Begamjangi, Dandari, Dashtlafashsabzo, Fard, Fofo, Haraksabzo, Hussainizard, Joshandakalut, Joshandasabzo, Khurmakarmachi, Khurmaikalut, Kungo, Mozawati, Rabi, Radag, Zardan, Zardpanjguri—; *Portuguese*: Palmeira, Tamareira—; *Punjab*: Khaji, Khajur—; *Pushtu*: Kajura, Shewa—; *Roumanian*: Curmal—; *Russian*: Phinikovoe dyerevo—; *Sanskrit*: Dipya, Hayabhaksha, Madhurasraoa, Mudarika, Phalapushpa, Pindakharjura, Pindakharjurika, Pindiphala, Rajajambu, Sapinda, Svadupinda—; *Sharig*: Khajur—; *Sibi*: Khajji, Khurma—; *Sind*: Kaji, Kurma, Pindchirdi, Tar—; *Sinhalese*: Ind—; *Spanish*: Datilera, Palma datilera, Palmera—; *Swedish*: Palmtrae—; *Tamil*: Ichu, Inju, Karchuram, Kuravam, Perindu, Perinju, Titti—; *Telugu*: Gajjuramu, Ita, Kharjuramu, Manjiyita, Muddakharjuramu, Peridu, Perita, Simakharjuramu—; *Turki*: Karmah—; *Urdu*: Khurma—; *Uriya*: Khorjjuri—; *Waziri*: Khajurra—.

5. According to the authors of the Encyclopaedia Mundarica *Kindad* is a stemless palm different from *Kita* (=*Phoenix acaulis* Buch.). The pinnae of its pinnatisect leaves are shorter and recurved at the end, they spread at a much greater angle to the axis than the pinnae in an *otekila* leaf.

The root-stock is pounded and thrown into pools and rivers to poison fish.

6. *Kitamuli* is said to be a stemless palm, different from *Phoenix acaulis* Buch. It has only two plicately multifid leaves like those of the male *acaulis*, and is said to die after two or three years. Its corm is slender having the size and form of a carrot, and containing nevertheless a farinaceous substance.

The mealy substance of the corm, edible in the *Kita*, is deadly poisonous in the *Kitamuli*. It acts as a vesicant and is, therefore, applied to the chest in pneumonia. It is also rubbed on the herpetic eruptions called *dinai*.

PINANGA.

This genus numbers about 50 species distributed over the Indo-Malayan region.

Pinanga dicksonii Bl. (=*Areca dicksonii* Roxb.) is found in great abundance on the mountains of Travancore and Malabar. It is gregarious and locally abundant in the evergreen forests near the Gersoppa and Nilkund Ghats of Northern Kanara.

The poorer classes eat the nut as a substitute for the common arecanut.

The dried husk of the fruit is used medicinally in China, Japan and Annam. It is in much request in flatulent, dropsical or obstructive diseases of the stomach. It is also given in choleraic affections.

China: Ta Fu Tzu—; *Malayalam*: Kanakamuka—; *Telugu*: Koondapoka—.

RAPHIA.

This genus numbers about 20 species which inhabit Tropical Africa and America.

Two of them are credited with medicinal properties.

1. Leaves rising straight up ... ... *R. ruffia.*
2. Leaves rising nearly vertically from the stem, bending out on every side in curves, forming a plume *R. vinifera.*

1. **Raphia ruffia** Mart. (=*R. pedunculata* Beauv.=*Sagus ruffia* Jacq.) is indigenous in Madagascar. It is extensively cultivated on the Mascarene Islands and naturalized in America.

The ROOT is given for toothache.

The fresh JUICE is a valuable laxative.

Dutch: Madagascarsche sagoboom, Sagodragende palm—; *English*: Raffia, Raffia Palm, Rafia Palm, Raphia Palm, Roffia, Roffia Palm—; *French*: Mouffia, Palmier de Mayotte, Raffia, Rafia, Raphia—; *German*: Bambuspalme, Madagaskarische Sagopalme, Raffiabastpalme, Raffiaweinpalme—; *Hova*: Rafia, Rofia, Voarafy—; *Madagascar*: Fomby, Maivanaty, Raofia.

2. **Raphia vinifera** Beauv. The Wine Palm grows in communities in the freshwater swamps of Lower Nigeria.

The SEEDS contain a bitter oil which in Guinea is much used for courbature and rheumatic pains.

In the Gold Coast the pounded seeds are thrown in pools and rivers to stupefy the fish.

Aowin: Dongkang—; *Ashanti*: Adobair—; *Awuna*: Alati—; *Dutch*: Raphiavezelpalm—; *English*: Bamboo Palm, Jupatic Palm, Pharaoh's Date-palm, Wine Palm—; *Ewe*: Ala—; *Fanti*: Adobair—; *French*: Bourdon, Palmier à vin, Raphier—; *Ga*: Adobair—; *German*: Bambuspalme, Echte Weinpalme, Weingebende Sagopalme, Weinpalme—; *Krepi*: Adoka, Altai—; *Krobo*: Sowaircho—; *Malinke*: Ban—; *Nizima*: Dorka, Eduiri—; *Quittah*: Adoka—; *Twi*: Adobair—; *Wassaw*: Tombo—.

Trachycarpus.

The genus consists of three species inhabiting the Himalayas, China and Japan.

Trachycarpus excelsa H. Wendl. (=*Chamaerops excelsa* Thunb.) Fortune's Chusan Palm is found in Upper Burma and extends through Yunan to China and Japan.

The FRUIT is astringent.

Chinese: Tsung Lu—; *English*: Fortune's Chusan Palm—.

Wallichia.

The genus numbers three species which inhabit India and Malaya.

Wallichia disticha T. Anders. occurs in the Gonda Hills of Oudh, the valleys of Sikkim Himalaya to 2,000 ft., the Makum forest in Assam. It is found in Upper Burma ascending to 4,000 ft. in the hills east of Bhamo, and on the Pegu Yoma, chiefly on the eastern slopes.

The BERRIES irritate the skin.

Lepcha: Katong—; *Lower Burma*: Letne, Zanaung—; *Upper Burma*: Minbaw—.

SNAKES IN BELGAUM.

BY

LT.-COL. K. G. GHARPUREY, I.M.S.

I had written a small note in the *Bombay Natural History Society Journal* of 15th July, 1930 (vol. xxxiv, No. 2, p. 585), on 'Snakes collected at Belgaum', in which 18 snakes seen by me there in 1927-1928 were mentioned. Of these, 3 were Phipson's Earth Snake, 5 common wolf snakes, 7 green keelbacks, 2 common Rat snakes or dhamans, and one Russell's Viper. This number was too small to find out the common species seen there. I happened to be re-posted to Belgaum again as Civil Surgeon in the rains and I started collecting snakes there as the rains bring them out in numbers. I saw and identified 65 snakes in six months from August 1933 to February 1934. The collection was interesting in that more species were seen than those in my previous note and I came across half a dozen cases of snake-bite also. Of the snakes seen 8 were cobras, so my remark at the end of my previous note, that cobras are not common does not hold good. Only few of the snakes were from the district, most of them being from Belgaum itself or its vicinity within a few miles. Of the 65 that were seen, 21 were poisonous (8 cobras, 6 common kraits and 7 Russell's Viper), nearly 33 per cent.—rather a high percentage.

The species were:—

Family: *Uropeltidae.*

1. *Silybura phipsoni* or Phipson's Earth Snake—9. A very common snake seen in the earth in the gardens and compounds. It is considered double-headed by some as its tail end is truncated and sliced. It is also called a Mud Snake.

Family: *Colubridae.*

2. *Lycodon aulicus* or Common Wolf Snake—9. Infant specimens were seen in August, so the hatching month seems to be July.

3. *Macropisthodon plumbicolor* or Green Keelback—10. Two were seen bottled in spirit in the British Military Hospital and one in the Sardar High School. Most of the others were seen about the Civil Hospital and its compound.

4. *Zamenis mucosus* or Common Rat Snake or Dhaman—4. One was seen bottled in British Military Hospital and one in the Vaccine Institute. One killed on 23rd September 1933 was 74 in. long and on dissection was found to have eaten a small snake and a lizard. One, killed on 30th January 1934, was 69 in. long.

5. *Zamenis fasciolatus* or the Fasciolated Rat Snake—2. Both these were small specimens 13 in. and 10¼ in. and were seen bottled in Sardar High School.

6. *Tropidonotus piscator* or the Chequered Keelback—1. It was 37 in. long and was shot in water. It had an olive-coloured back, flanked red due to the red laterite soil.

7. *Tropidonotus stolatus* or the Buff-striped Keelback or the Dandy Snake—3. One was preserved in the British Military Hospital and two were seen from the Fort, near the Superintending Engineer's bungalow.

8. *Coluber helena* or Trinket Snake—1. Seen also bottled in Sardar High School.

9. *Dipsadomorphus trigonatus* or Common Brown Tree-snake —1. Small specimen 13 in. long; killed near the Civil Hospital.

10. *Dendrelaphis tristis* or Seba's Bronze Back—1. This good specimen was sent from the District by Mr. Rowlands, D.S.P. It was 41 in. long.

11. *Dryophis mycterizans* or the Green Whip Snake—1. A fine specimen sent from the district by Mr. J. Harris, A.S.P. It was nearly 6 ft. long (71 in.).

12. *Bungarus caeruleus* or the Common Krait—6. Three were seen preserved in the British Military Hospital and one in the Sardar High School. Two were brought from the Military Dairy Grass Farm area about 2 miles from Belgaum, one male 37½ in. and a female 36 in. long.

13. *Naia tripudians* or the Common Indian Cobra—8. All were binocellate. Two were seen preserved in spirit in the British Military Hospital, nicely set up with the hood expanded showing the ocelli well. One was seen bottled in the Vaccine Institute. Two were killed in the Fort, both 57 in. long. Three were brought from the Military Dairy Grass Farm; two of these, biggish specimens, were lying together and brought on 27th January 1934, one being male 59 in. long and the other a female 60 in.

Family: *Viperidae.*

14. *Vipera russelli* or Russell's Viper—7. One was seen bottled in the British Military Hospital and one in the Vaccine Institute. Two were killed in the Military Dairy Grass Farm area, one 51 in. and one 42½ in. One was killed near the cookhouse of the Senior Officers' School Mess on 5th November 1933 and was 45 in. long.

One was killed on 19th November 1933 at Dupdhal, near Gokak. This one, 39 in. long, had bitten a P.W.D. cooly working in the grass in the late afternoon. Fortunately Mr. J. Brooks, District Forest Officer, was there. He gave prompt first aid and took the cooly in his car to the Gokak Mill Dispensary where the bitten person got intravenous Antivenene within an hour of the bite, and the man recovered completely without showing any symptoms. Mr. Brooks sent the snake also the same evening to me at Belgaum for identification.

Another one bit a person in the garden near the Hindalgi Jail about 12 noon on 1st February 1934. The snake was killed and brought to me at the Civil Hospital by the Junior Medical Officer who came on his motor-bike, got it identified as Russell's Viper returned with the Antivenene, and the bitten person received the injection within an hour of the bite and there was complete recovery.

Both these cases show that if people do not waste time but carry out prompt treatment, the bitten person has a very good chance of quick and complete recovery.

There is a village called Turgamatti about 2 miles from Belgaum, near which are acres of land belonging to the Military Dairy Farm where grass is stacked. These stacks are a good sheltering place for snakes. When one stack was nearly cleared, the men working there found a large number of snakes at the bottom. Only the big snakes were brought to me, some alive and these were 3 Cobras, 2 Russell's Vipers, 2 Kraits and 1 Dhaman, all except one being caught in the month of January.

MISCELLANEOUS NOTES.

I.—A TIGER FEEDING ON A COW WHILE YET ALIVE.

With reference to the paragraph in the Review on Mr. Peacock's book at page 206 of vol. xxxvi, No. 1 of this *Journal*, 'Has anyone ever known a case, in India, of an animal being fed upon by a tiger when alive? That, surely, must be peculiar to the tiger of Burma.' Mr. M. Freeman of Madras relates for the information of the writer that in 1930, when in the Palni Hills at the small village of Pambarai some twelve miles from Kodaikanal, he was taken late one evening by the village munsiff to a cattle-shed. Inside two cows were lying dead, killed by tigers and partly eaten, while a third one was lying on its rear side with the whole of its right haunch eaten, and the stomach so torn that a portion of the bowel was protruding. This cow was alive, chewing the cud, and did not appear to be suffering greatly.

Proceeding at dawn next day with a shot gun in order to shoot the cow, and using an electric torch to give light into the shed, Mr. Freeman found himself facing a tiger, backed a few steps, and, as the animal came out and made off, fired at it with S.S.G.

It was then announced that there was another tiger in the shed, and this beast was killed as it rushed out by one shot from a .500 express rifle.

The first animal was then beaten out of adjacent cover and killed; these two beasts measuring 7 ft. 2 in. and 7 ft. 4 in. One of them a female.

It was found that during the night the tigers had fed upon, and almost completely demolished, the live cow.

The uproar made by the villagers proceeding with the slain to the local temple roused a third tiger which Mr. Freeman wounded, and then killed by a shot in the chest as it bounded towards him.

The next morning the villagers brought to Kodaikanal the body of a fourth tiger, which they had managed to kill, after watching it go into the cattle-shed. They hammered a big stake in the doorway to keep it closed and shot the tiger by the light of a lantern lowered through a hole in the thatched-roof.

Mr. Freeman does not note the size of these two other animals, or whether either of them was mature, so it may be that all four were immature. If this was so, possibly they had been deprived early in life of their mother and been forced to feed themselves without the usual tuition in expert methods of killing.

This instance, the first heard of by the writer during a residence in India of forty-five years, and the first to be recorded in the pages of the *Journal of the Bombay Natural History Society* during the half century of its publication, is not of the kind referred to by the author of *A Game Book for Burma*. It is within the experience of many sportsmen, past and present, in Burma, that a full-grown able-bodied tiger not infrequently commences eating while the animal brought down by its attack is still alive.

The instance now noticed is of immature animals acting in this way, and must be, even in that case, a very exceptional occurrence.

COONOOR. R. W. BURTON.
October 25, 1934.

II.—RECORDS OF SOME CLOUDED LEOPARD (*NEOFELIS NEBULOSA*) IN THE DARJEELING DISTRICT.

(*With a photo*).

1. January 1920. 3,000 ft., near Kurseong. Length of mounted skin 6 ft. 9½ in. Upper canines outside 1¾ in. Breadth of skull 4¾ in. Male.

2. January 1920. Same place as No. 1. Length of mounted skin 6 ft. 5½ in. Upper canines 1½ in. Breadth of skull 4½ in. Male.

Clouded Leopard (*Neofelis nebulosa*) in Darjeeling District.

Both these animals were shot in the same beat by one gun, as they came out together.

3. May 1926. Same place as No. 1 and 2. Male. Shot over a goat kill. All Nos. 1, 2 and 3 were full-grown with grey rather than fulvous predominating and appeared to be in their prime.

4. August 22, 1926. Runjeet Valley, 2,500 ft. Length 5 ft. 5½ in. Weight 42½ lbs. Male. Shot in a beat in *sal* jungle.

5. December 23, 1926. Runjeet Valley, 2,500 ft. Greyish. Head and body 3 ft. 1 in. Tail 2 ft. 6 in. Weight 48½ lbs.

Height at shoulder 21 in. Girth of fore-arm 9½ in. Male. Picked up dead after an all-night fight with another leopard, species unknown. Greyish. Photo enclosed.

6. February 2, 1928. By the side of the Runjeet River, 1,000 ft. A favourite haunt of jungle fowl. Length 4 ft. 8 in. Weight 39 lbs. Male. About 10 in. had been severed from the end of the tail. Shot up a tree. A rich fulvous with whitish underparts.

7-8. October 1932. Two females length 5 ft. 6 in. and 5 ft. 1 in. respectively found dead side by side at the foot of a 100 ft. cliff by the side of a side stream of the Teesta River. 2,000 ft.

9. May 12, 1934. Above Rungbee. Teesta Valley, 2,000 ft. Very old female found dying and killed off by dogs. Skull sent to the Society for examination. Skin very greyish with poor markings.

NAMRONG, W. H. MATTHEWS.
RUNGLI RUNGLIOT P.O.,
N. BENGAL.
August 19, 1934.

III.—NOTE ON A BEAR AND A PANTHER OBTAINED BY COL. F. M. BAILEY FROM TIBET AND A PANTHER FROM ASIA MINOR OBTAINED BY MR. J. E. WHITTALL.

The following supplement to my accounts of the Asiatic Panthers and Bears published respectively in the *Journal of the Bombay Natural History Society*, xxxiv, pp. 64-82, 1930 and xxxv, pp. 771-823, 1932, is based upon the skins of two rare panthers and the skin and skull of an equally rare bear recently received at the Natural History Museum.

One of the panther skins was most generously presented to the Museum by Col. F. M. Bailey who, while recently in Kashmir, received it from a Tibetan with the information that it came from near Shigatse, south of the Brahmaputra, some 100 miles north of Sikkim, a district from which no panther, so far as I am aware, has as yet been recorded. It is clearly a winter skin and is one of the most beautiful I have handled. The coat is full and long, about 45 mm. or 1¾ in. in length. The ground colour is rich orange yellow, paling to buff on the paws and low down on the flanks where the tint passes into the white of the belly. Everywhere on the upper side the under hair is dark smoky grey to a height of about 19 mm. from the skin. The pattern consists of rather close-set, medium-sized black rings not broken up into spots.

I am at present unable to distinguish this panther from the race I described in this *Journal* as *Panthera pardus bedfordi*, the original example of which came from S.-E. Shensi. But the discovery of this panther south of the Brahmaputra suggests that it may possibly extend its range to the northern slopes of the Himalayas which would bring it within the precincts of the Fauna of British India. The skull of the Tibetan specimen was unfortunately not preserved.

The second panther skin is of a very different kind. It belongs to the Asia Minor race *Panthera pardus tulliana* of which, as recorded in my paper, the Museum had previously only a single skin in a poor state of preservation, collected many years ago in Anatolia. The new skin came from the mountains near Karajahissav, South-East of Kuluk in South-West Asia Minor and was kindly presented to the Museum by Mr. E. H. Givand at the request of Mr. J. E. Whittall of Constantinople with whom I had been in correspondence regarding the Museum's requirements in the way of mammals from Asia Minor. This panther is a particularly important addition because, as I learn from Mr. Whittall, it is now very rare.

The skin is in summer coat, the hair being short and sleek; the colour of the median dorsal area is ochreous buff gradually fading on the flanks and limbs and passing into white on the belly and into cream or buffy white on the paws; the tail is pale with some buff alongside the spots on the basal half, the terminal portion being grey; the hairs in the terminal third of its length gradually lengthen and are long at the tip; the pattern consists of well-spaced annular rosettes, mostly broken up into spots. This skin is paler in colour and shorter in the coat than the skin from Anatolia and was evidently killed at a different time of the year.

The Tibetan Bear is an example of the so-called Snow Bear (*Ursus arctos pruinosus*). The condition of the coat which is long, thickened with abundance of underwool and tufted suggests that the animal was killed soon after emerging from winter quarters. The general colour is black, showing dark brown patches of underwool when the hair is parted; but the tips of the hairs of the crown, nape, on each side of the shoulder mat and on the middle of the back are extensively yellowish tawny; this tawny hue dies away on the hind quarters and the hairs of the flanks are only faintly tipped with grey. There is a dirty white collar extending from the breast up the sides of the neck but not passing over the nape. The face and cheeks are tawny-brown and there is a good deal of tawny on the chest behind the fore legs, which like the hind legs are black. The claws are 'horn-coloured' and the toe pads are not united as described by Lönnberg.

This skin being in dead coat entirely lacks the coppery or silvery lustre I described in connection with Fenwick Owen's skins from W. Kansu which were collected in October.

The following are the dimensions of the skull in English inches and of the teeth in millimeters.

In English Inches.						In millims.			
Total length	Cond. basal. length	Zygom. width	Mastoid width	Int.-Orb. width	Max. width	Last 3 upper teeth	Last upper tooth	Last 4 lower teeth	Penult. lower tooth
14·7	13·8	8·1	6·5	1·1+	3·1	7·7	37 × 21	91	28 × 16

The general conformation of the skull and the open basioccipital suture show that it had not reached full size but in total length it is only about 3 mm. shorter than the longest entered in my table, which was recorded by Leche, and it would certainly have surpassed the latter considerably, when full grown. The zygomata are narrower; but that is a matter of age. The teeth are actually and relatively small, the length of the last upper molar, 37 mm., coming between the two smallest examples of this tooth recorded in my table, namely those of the ♀ from Kansu, 39 mm., and the ♀ from North-East of Lhasa, 35 mm.

British Museum (Natural History), R. I. POCOCK, F.R.S.,
London. (*Unofficial Assistant in Zoology Department.*)

IV.—WILD DOG (*CUON DUKHUNENSIS*) KILLED BY DOMESTIC DOGS.

A wild dog was killed by two dogs owned by a friend of mine Mr. H. Vaughan Arbuckle on the neighbouring Estate of Sirikundra last month.

Mr. Arbuckle's dogs are a beagle from Ceylon, and a small cross bred Airdale—Irish Terrier. The latter is an exceptional game little devil with a predominance of Irish blood and they both spend a good deal of time hunting anything that runs from Civet cats to deer.

Mr. Arbuckle was in a field of tea superintending plucking coolies when his dogs started kicking up a terrific racket close to him. Before he could get to them they started to run and after a very short hunt he came up with them mixed up in a rough and tumble with a wild dog which they were just finishing off. The wild dog was about three-quarters grown, his testicles having not long dropped. I saw the skin subsequently myself but unfortunately it was not cured and has since decomposed.

It seems incredible that a wild dog with his great speed should not be able to get away from domestic dogs if he wanted to. When finally killed he was in a pretty good mess and it was very difficult to sort out his injuries, but Mr. Arbuckle advances the theory that his two dogs probably ham-strung him in one leg by a lucky bite when they first bayed him in the tea. The two dogs came out of the scrap with very little damage in which they must have been extremely lucky.

There is a considerable amount of virgin evergreen forest and Cardamom jungle round the boundaries of Sirikundra Estate which contains a lot of sambur and barking deer and wild dogs are constant periodical visitors. For some time past there has been a pack of four dogs hanging about, a large dog, a bitch and two small dogs presumably her pups. In all probability, the dog killed, was one of these pups which was very likely either sick or had been damaged in a hunt and was lying up asleep in the tea when it was surprised.

Monica Estate,
Valparai P.O.
August 31, 1934.

J. WILLIAMS.

V.—TIME OF SEXUAL MATURITY OF THE ELEPHANT (*ELEPHAS MAXIMUS* L.).

Mr. Gordon Hundley's very interesting letter of February 26, 1934 in vol. xxxvii, No. 2, records certain details regarding Burmese elephants which accord closely with facts recorded from South India. In Coorg, a Forest Department tusker named Krishna came into *musth* when his age was believed to be only 15 years. A Madras Forest Department cow elephant, Meenakshi, herself born in captivity, calved when she was only 13 years old, two years younger than the cow mentioned by Mr. Hundley. Meenakshi was the daughter, by a wild bull, of chik Lakshmi, who was the daughter of Lakshmi. Tradition has it that Lakshmi was a Burmese elephant transferred from the Commissariat Department. Meenakshi's son referred to above, Dosti Jehan, was a muckna, and being also precocious like his mother, was a father at 20, his son Abdul Ali being a tusker. The last-named is now 11 years old, so before many years the Forest Department may expect the arrival of the sixth generation of this family.

Salem.
September 6, 1934.

G. C. ROBINSON,
I.F.S.

VI.—A BULL GAUR (*B. GAURUS*) AND A TIGRESS FIGHT TO DEATH.

I have read with interest Mr. W. S. Thom's Notes on Bison (*Bibos gaurus*) in Burma (vol. xxxvii, No. 1), in which he states 'Bison have only two enemies to fear, viz., tiger and man, but the former is no match for a full-grown bull'.

In view of this statement, the following may be of interest to readers of the *Journal*. In October 1931, on my return from leave, to my Forest Division, I was informed by some of my sawyers that about 10 days previous to my visit to their camp, they, whilst roaming about the forest, had come across the decomposed carcases of a bison and a tiger lying within 10 feet of each other. I visited the spot, and from what I saw, I was convinced that a battle royal had taken place, which had ended in the death of both combatants. For a radius of about 40 feet the jungle had been absolutely cleared, small saplings broken, and from the large trees chunks of bark had been torn off. The carcases were lying within 10 feet of each other, and on examining them I found that a tigress on one hand, and a bull bison in the prime of life on the other had been the combatants. The incident took place in the Makri Reserve on the Bastar State, C.P., which is a sanctuary for buffalo, bison and *barasingh*, and my statement can easily be verified by referring to the Forest Officer of the State, who enquired into the matter, and sent subordinates to inspect the spot.

Camp Bardulla,
Mainpur P.O.,
Via Rajim, B.N. Rly.
September 7, 1934.

H. V. BLACKBURN.

VII.—WHITE BISON.

In your issue of August 15, 1934, Mr. Morris has asked if I would refer to the appearance of these animals 'from a considerable distance' as being 'startling'. The answer is most emphatically 'yes'. It is for this reason that I made special mention of the variety in 'Wild Animals in Central India'.

I am probably as familiar as Mr. Wilson with the normal variations of colour, including light coloured animals. The bison however to which I referred do not come within this category, they are 'startling' different.

In my original description I referred to them as 'dormouse coloured'. Mr. Morris in his description calls them 'sandy or light fawn'. My point is that these are identical descriptions, as anyone who knows a dormouse will agree. We now get Mr. Wilson multiplying confusion by calling them 'a very light cream'. The above is evidence of the difficulty of describing a shade of colour in terms of language.

It is hoped that your Society will procure a skin from the Central Provinces and from Madras: it will then be possible to determine what difference if any, exists between specimens from these two parts of India. It is probable that a good many years may elapse before a C.P. specimen is secured. I base this statement on the fact that I have seen hundreds of bison on hundreds of occasions, all over the C.P., but only on very rare occasions have I seen a so-called 'white' variety. Your Society on procuring specimens could more precisely define the colour description, and possibly suggest a name.

I never suggested that they should be called 'Dormouse-coloured Bison' as Mr. Wilson implies, the nomenclature is far too clumsy to start with.

Mr. Morris makes a point over the adjective 'white' being applied to the Rhino: when that animal was christened sportsmen attached much less importance to scientific accuracy. Were the

'White Rhino' discovered today, it would probably be called 'The Grey Rhino' and to my mind preferably so. In adopting therefore a specific name to a particular variety of bison, I would advocate, if possible some qualifying adjective, which is less of a misnomer than 'white'.

September 18, 1934. A. A. DUNBAR BRANDER.

VIII.—RATELS AND CORPSES.

I have read in your last issue a note under the above title from Mr. Dunbar Brander, in which he takes exception to my not having written to him personally before casting doubts in my recent book as to the accuracy of his statement that ratels are in the *habit* of exhuming corpses. Before answering what he writes I would like to say that I am a profound admirer of Mr. Dunbar Brander's excellent book, which I consider to be one of the best works ever published on the subject, and I am sorry to have caused him offence by disagreeing with just one of the statements contained therein.

He says that, as a self-appointed judge, I have confused the word 'exhume' with the word 'eat', but surely that is rather a quibble. If a ratel exhumes a corpse it is presumably not for the fun of doing so, or because he admires its pretty shape and appearance, but because he wants to eat it or the grubs that it contains, which is practically the same thing.

I wrote that 'So far as I am aware, no reputable naturalist has ever obtained first-hand evidence of such an act'. It would certainly have been better if I had used the word 'recorded' instead of 'obtained' but the purpose of a Journal such as this is to record observations on animal life, and I have found no such record either in this *Journal* or in any book that I have ever read. Hence it seems to me singularly unfortunate that Mr. Dunbar Brander could not have found space in his book or in a note to this *Journal* for the interesting experience that he now relates. However, 'better late than never' and he has now given a single instance of a ratel having exhumed a corpse, although, even so, it appears to have been a deduction only that a ratel was the culprit, with no actual eye-witnesses. It is also possible that some other readers of this *Journal* may be able to provide further isolated instances, but Mr. Dunbar Brander has quite failed to appreciate the whole point of my argument. What I wrote was 'an exceptional ratel may very rarely happen upon a corpse and sample it, but the exhuming of corpses is most certainly not a *habit* of this species'. I still stand by that statement until I am proved wrong; and it seems to me deplorable that a man with the vast experience of Mr. Dunbar Brander can dare to state as evidence, on the grounds that he has *once* come across a single case, that 'the name of grave-digger is *thoroughly-earned*, as I have known them exhume a (a single !) corpse. I once had to give evidence of this *habit*.

. . .' The word habit means 'settled tendency or practice', and this 'self-appointed' and discredited judge is not prepared to accept one single instance during the long service of an experienced observer like Mr. Dunbar Brander as justification for the employment of the terms 'thoroughly earned' and 'habit' in evidence. Further, my book was essentially a book concerning the animals of the jungle and I do not spend my time outside my charge sitting in Mohamadan cemeteries trying to catch an odd ratel, probably desperate for food, trying to exhume corpses. My judgment is therefore 'not proved' as regards the charge that ratels are in the *habit* of doing this, although, as I wrote in my book, an exceptional ratel might be proved guilty.

As regards burrows, I think that Mr. Dunbar Brander's memories of the North Kheri forests must have become somewhat blurred since he retired. About two-thirds of the total area (I can give the exact figures if he likes) of these forests consist of an elevated plateau bounded by steep banks or 'damars', and the greater part of this plateau is not liable to flooding. It therefore affords excellent opportunities for good and dry burrows, particularly on the 'damars'. Yet, as I stated in my book, I never succeeded in finding an occupied burrow or den even in that favoured locality.

As Mr. Dunbar Brander remarks, it is impossible to say if the peculiar colouring of the ratel has been specially developed for protective purposes, but the subject is of great interest and I do not agree that the argument that the moon does not function continuously can be dismissed quite so easily as Mr. Dunbar Brander appears to assume. Perhaps he can tell us for what purpose ratels require protective or assimilative colouring?

I have been attacked in a Bombay newspaper for claiming that the ratel is the hero of the jungle and I have now been taken to task by Mr. Dunbar Brander for daring to disagree with him as to the justification for the insulting name of grave-digger. I am sorry that my humble effort to stand up for ratels has caused such a storm, but I do think it such a pity to give any wild creature a bad name without proof that the name is thoroughly earned. There is quite enough indiscriminate killing (apart from genuine sport) going on as it is without providing further excuses for destroying wild creatures.

In conclusion I would point out that, after all, neither Mr. Dunbar Brander nor I know much about ratels. It would therefore help if all readers of this *Journal* who are interested in the subject would send in any observations that they may have made, so that we may perhaps come to learn a little more concerning the habits of these most interesting creatures.

CAMP, *Via* ALMORA, F. W. CHAMPION,

U.P. I.F.S.

January 2, 1935.

IX.—A HYBRID AMERICAN BISON AND DOMESTIC COW AT THE MYSORE ZOO.

(*With a plate*).

Thinking that it may interest your readers I am sending you a photo of a cross between an American Bison and a half-bred cow. The second photo shows the mother with the young one. In another two weeks we hope to have another similar one born at the Zoo.

THE PALACE,
MYSORE.
October 2, 1934.

SADEG Z. SHAH,
Assistant Secretary to the Maharaja of Mysore.

[The above is a result of some experiments in cross-breeding which are being carried out at the Mysore Zoo. Two previous attempts were made to cross American Bison with domestic cattle but unfortunately both the mother and young succumbed.—EDS.]

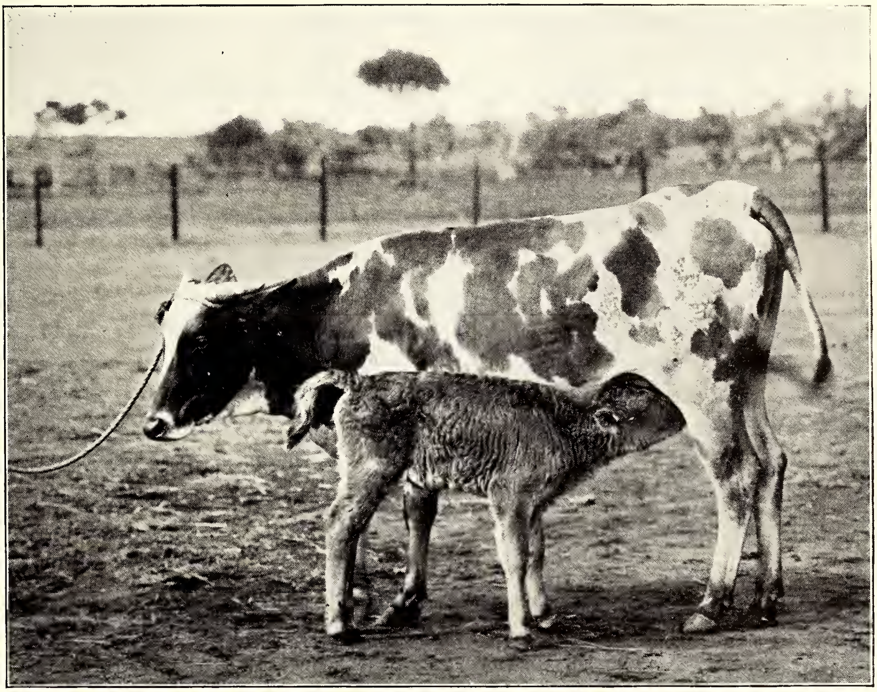
X.—THE LOCH NESS MONSTER.

The trouble is that most of the witnesses are utterly ignorant of nature and what to look for; they are only all at one, in being prepared to see a monster—and anything unusual is a monster. The evidence quite satisfies me that on a number of occasions a school of otters moving in single file, as they do, has been taken for the monster, each otter forming a hump. If I had been asked to guess what that photo was (knowing nothing of the monster) I would have said, 'An otter preaching in the water'. They can sit right up for an interval, like a dog begging, to look round, and imagine the leader doing this with perhaps half a dozen behind him, e.g. the monster. Last week a witness said it travelled in to the shore, and then along the shore in 6 inches of water for some distance, and had 6 humps; 7 otters obviously—the leader being the monster's head and the other 6 the humps. The photo was quite genuine and *bona fide* all right. There has been nothing published lately which at all indicates the real monster having been seen, but a very large grey seal was seen in the bay off Ness Mouth.

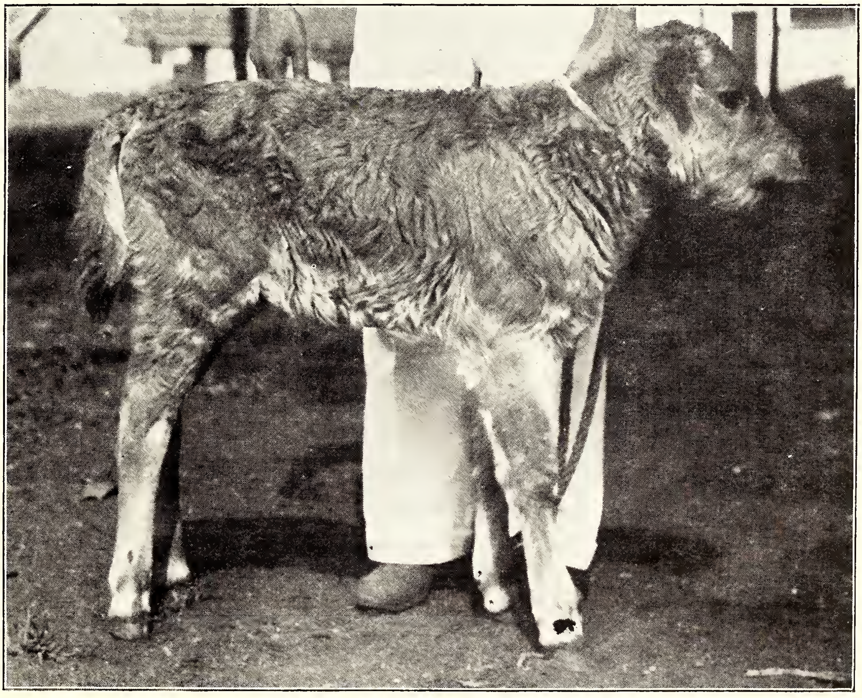
August 1934.

A. A. DUNBAR BRANDER.

[The above is an extract of a letter addressed to Mr. J. Ridland by Mr. Dunbar Brander.—EDS.]



Hybrid American Bison Calf with parent half-bred cow.



Hybrid American Bison Calf, Mysore Zoo.

XI.—OCCURRENCE OF THE BLACK-HEADED CUCKOO SHRIKE (*LALAGE SYKESII*, STRICKL.) IN THE HOSHIARPUR DISTRICT OF THE PUNJAB.

One of these Cuckoo Shrikes was obtained near Bharwain in the Hoshiarpur District on August 6, 1934 and another in the same locality on the following day. Bharwain (3,200 ft.) is situated on the crest of a range of the Siwalik foot-hills which here forms the boundary between the Hoshiarpur and Kangra Districts. Both birds were males with organs in breeding condition. Mr. Hugh Whistler, to whom they were sent, informs me that this is the first record of the bird in the Punjab, to which it had not previously been recorded nearer than Bareilly; it is probably a rains visitor.

AMBALA,
PUNJAB.
October 28, 1934.

H. W. WAITE,
M.B.O.U.,
Indian Police.

XII.—OCCURRENCE OF THE GREY-FRONTED GREEN PIGEON (*DENDROPHASSA POMPADORA AFFINIS* JERDON) IN THE KOLABA DISTRICT.

Blanford in the *Old Fauna* stated that the Grey-fronted Green Pigeon (*Dendrophassa pompadora affinis*) was to be found in the 'forests of Malabar from the neighbourhood of Bombay to Cape Comorin'. He discredited Jerdon's records from Central India and the Eastern Ghats.

Sinclair, reviewing Blanford (*J.B.N.H.S.*, vol. xii, p. 185), wondered what brought Bombay into Malabar, and recorded seeing a specimen shot in the Police Lines at Alibag, Kolaba District (North Konkan).

Barnes in his *Birds of Bombay* said it occurred in the Sahyadris as far north as Khandala.

On 25th February, while 'doing' Karnala Fort (Funnel Hill), Panvel Taluka, Kolaba District, with Messrs. N. Futehally and C. McCann, I saw several of these birds in heavy forest at about 1,000 ft., and later obtained a specimen on the road under the hill.

It would therefore appear that the 'Distribution' in the *New Fauna* 'West Coast of India from Kanara to Cape Comorin' stands in need of correction.

GODREJ HOUSE,
ANDHERI.
March 8, 1934.

HUMAYUN ABDULALI.

XIII.—OCCURRENCE OF THE GREAT INDIAN BUSTARD (*CHORIOTIS NIGRICEPS*) NEAR SAUGOR.

I write to inform you that on Sunday, July 15, while out shooting blackbuck on the Dhana Ridge—a locality about 12 miles distant from Saguor East by E.S.E.—I and two friends spotted a Great Indian Bustard. It was stalked for about 10 minutes, and eventually shot with a rifle; it obviously saw its pursuer but would not take the trouble to fly, but rather seemed to prefer hiding behind such bushes as were there.

This took place at about 8-30 a.m., and the bird was eaten the next day. It had a very strong flavour (not 'gamey'), and was very tender.

As this bird is supposed to be very rare in these parts, I thought you might be interested to hear of its being seen and shot.

OFFICERS' MESS,
3/15th PUNJAB REGIMENT, E. P. DEEKS.
SAUGOR.
July 1, 1934.

XIV.—ABUNDANCE OF THE FANTAIL AND PINTAIL SNIPE.

I send you these two observations on these two common snipe made by myself and confirmed by one or two friends and hope that they are original and interesting, and that they may be confirmed by shikaris in other parts of India.

(1) The incidence of snipe (Common, Fantail and Pintail) varies with the incidence of the Pintail, e.g., in a bad snipe year only few Pintail come over and in a good year many Pintail. Apparently Fantails are fairly constant in number each year.

(2) The last snipe to return are Pintail. At this time of the year they are usually mistaken for Fantails by the unwary as the pins have shed their fluff and this is usually not noticed. The other ordinary characters relied upon by the common or garden man i.e. the crochet hook top beak of the Pintail and the spatulate top beak of the Fantail however easily give away the birds.

PORAHAT FOREST BUNGALOW,
CHAIBASSA P.O., B.N. RY. P. W. AUGIER.
September 6, 1934.

XV.—BIRD NOTES FROM BURMA.

The following I record, for what it is worth, from Burma.

1. A pair of Luggur Falcons breeding on a cotton tree (Letpanbin) on the Loikaw Plain, Karenni, South of S.S.S.

Have these falcons been observed east of this?

2. I have seen the large solitary Cineraceous Vulture twice in Burma—once on the flat lands by the Taping River in the Bhamo District—and once on the high lands near Namkham on the Chinese border of the N.S.S.

It has not been recorded from Burma and Shelein.

3. A starling, species or race unknown, at Bhamo. This was a solitary bird feeding with the Mynas out on the flat lands south of Bhamo. In appearance it was exactly like the Starling of Kashmir.

TAUNGGYI, S.S.S.,
BURMA. T. R. LIVESEY.
September 14, 1934.

XVI.—A COMMENT ON 'THE NESTING HABITS OF THE SMALL SUNBIRD (*LEPTOCOMA MINIMA* SYKES) PUBLISHED ON PP. 730-732 OF THE *JOURNAL* VOL. XXXII.

Professor Nayar's breeding record of the Little Sunbird at Ernakulam is interesting. During my recent bird surveys of Travancore and Cochin I failed to come across this species in the low country along the backwaters and coast and found it confined to evergreen forest tracts commencing with the hummocky broken country further inland and extending up to about 5 or 6 thousand feet in the hills. Ferguson (*J.B.N.H.S.*, xv, 473) also found it common in the hills only.

As I had found both *Leptocoma asiatica* and *L. zeylonica*, especially the latter, common in the low country near the coast, I wrote to Prof. Nayar asking for confirmation of his record. In reply he states that he has no doubt as to the correctness of his identification since he is fairly familiar with both the Purple and the Purple-rumped Sunbirds and his note refers to neither of them. So far so good.

The next point is less clear. Mr. Nayar notes that the nest was examined by him on the evening of 11 February and found empty, whereas at 4-30 p.m. the next day it contained two eggs and that 'there was no doubt that the eggs were laid on this day, i.e., 12 February'.

As the laying in one day of two *normal* eggs—as evidenced by the fact of both hatching later—is contrary to experience and to the condition usually prevailing in a state of nature, I suggested to Mr. Nayar that he may perhaps have overlooked the presence of the first egg in the nest on 11 February. Mr. Nayar in replying says: 'About the other point you have raised, I think I have possibly made a mistake. There was probably one egg in the nest on the 11th evening which I failed to feel. The next day I am sure there were two eggs because not only did I feel them but I also saw them by craning over the mouth of the nest to enable me to peep into it.'

The interval between the laying of eggs in almost all Passerine birds is the same as in the domestic hen, viz., 20 to 24 hours. Laying may at times be voluntarily retarded owing to adverse environmental causes, but only in very exceptional cases is the interval shortened and then it is usually due to some pathological condition, the eggs thus laid being malformed and unproductive. In the case of *Leptocoma asiatica* and *L. zeylonica* I have repeatedly found the interval between the laying of the first and second egg to conform to the usual rule in this Order, being something in the neighbourhood of 22 to 24 hours.

An extraordinary occurrence as described in the note requires careful verification before it is accepted as a fact. In the absence of such evidence it must remain a doubtful if not inaccurate record.

DEHRA DUN, U.P. SALIM A. ALI.
January 22, 1935.

XVII.—A DHAMAN (*PTYAS MUCOSUS*) 'RATTLING' ITS TAIL.

The other day I was walking along a dusty Gujerat road when a rustle in a *Euphorbia* hedge drew my attention to a bull-frog in the grip of a large dhaman. Picking up a piece of dry earth, I flicked it at the snake. It raised its head a few inches off the ground and rapidly struck its tail against some dry leaves, producing a steady rapping noise distinctly audible at a couple of yards. On further irritation, the snake glided off carrying the frog some 9 inches off the ground.

The American rattle-snake is well-known to have a similar but greatly specialised method of warning. Is this habit common among snakes? I would be grateful for any information that you may be able to give me on the matter.

GODREJ HOUSE,
ANDHERI. HUMAYUN ABDULALI.
October 4, 1934.

[A rapid muscular movement of the end of the tail is a reaction observed in many snakes when under stress of excitement. It is developed in a marked degree in the rattlesnake and in this species has resulted in the evolution of the peculiar rattle apparatus. Most vipers display this habit. The Green Pit-Viper (*Lachesis gramineus*) rapidly vibrates the tip of its tail when about to strike at its prey. It is a uniformly green snake; in some individuals the tip of the tail is red. The theory is that the red end of the tail sharply differentiated from the rest of the body by its colour, takes the semblance and movements of a worm and so draws the attention of birds etc. on which the snake preys. This is the theory. There are many such theories and how far they are correct we do not know. The habit is common also in many Colubrine species and in Boas and Pythons.—EDS.]

XVIII.—A CLEAR-WINGED MOTH (*PARANTHRENE* SP.) MIMICKING A SCOLIID WASP (*SCOLIA AURIPENNIS* LEPEL).

While botanising at Andheri (Salsette Island) during the month of August this year (1934), I noticed some Scoliid wasps collecting the pollen from the flowers of the *Leea* then in bloom (*Leea crispa* L. and *L. sambucina* Willd.). Numbers of these wasps were collected on almost every inflorescence. On one inflorescence among the wasps there was one which to all intents and purposes looked like a Scoliid wasp, but with an inexplicable *something* about it which attracted my attention and singled itself out from the others. Its colour, size, shape and its behaviour as it moved over the flowers among the wasps, were Scoliid, but yet that *something* distinguished it from its fellows. I watched it for a time but could not fathom the mystery. I caught it in a glass tube and on close examination, to my astonishment discovered that the 'wasp' was really a moth! It was an exact replica of the Scoliids. Mimicry is a well-known phenomenon in the insect world, but what particular advantage did this moth derive from such mimicry and association? Protection from its would be enemies! There is much room for speculation, but the answer will be only found by unveiling the life-history of these two insects.

On further investigation I discovered that the appearance of the wasp was linked with the flowering period of the *Leea*. A few wasps appeared during the early period when the *Leeas* were in flower, but they 'disappeared' when the flowering season terminated. Where do the wasps go? The answer is awaited.

The specimen of the moth was submitted to the Entomological Department of the British Museum (Natural History) for identification. Mr. Arrow in replying wrote:—'I am returning the Clear-Winged Moth sent to me for identification. It has been examined by Mr. Stringer who finds it to be a species of *Paranthrene*, unknown to us, but near *celebica* de Cerf. The Family is *Aegeriidae*. It is very interesting to know that the specimen was found in company with the Scoliid which it resembles.'

Four interesting points arise from this small observation:—

(1) The fertilisation of the two species of *Leea* by the wasp *Scolia auripennis*.

(2) The mimicry of *S. auripennis* by *Paranthrene* sp.

(3) The possible existence of a new species of *Paranthrene*.

(4) The periodical 'appearance' and 'disappearance' of the wasps, their movements being apparently controlled by the flowering of *Leea*.

BOMBAY NAT. HIST. SOCIETY,
BOMBAY.
December 5, 1934.

C. McCANN,
Assistant Curator.

XIX.—A NEW SPIDER OF BENGAL, MIMICKING *OECOPHYLLA SMARAGDINA* (FABR.).

(*With three text-figures*).

So far as I am aware, two species of spiders have been recorded by different authors, as mimics of the red-ant (*Oecophylla smaragdina*);[1] one of them, *Myrmarchne plataleoides* of the family *Salticidae* or *Attidae*[2] is a perfect mimic while the other, *Amyciaea forticeps*, Camb. of the family *Thomisidae*[3] is not so prominent.

In 1931, while collecting spiders from Lonsing, a village in East Bengal, I came across a peculiar female spider with its small pea-like faint brownish cocoon hanging from some tiny irregular silk-lines upon a middle-sized plant (*Nyctanthes arbor tristis* Linn.). The red-ants were in abundance upon the plant, though the spider itself was not found in company with them. She was very busy with her cocoon on a secluded branch of the plant. From external structure, the spider seems to be of the genus *Propostira*, Simon, of the *Theridiidae* family and is described below under the name *Propostira ranii*, sp. nov.

The spider showed a peculiar resemblance to *Amyciaea forticeps* Camb. in colour and in some other respects; but there are some striking differences in the formation of the body and its appendages. This seems to exhibit 'protective mimicry' or 'beneficial likeness' to *Oecophylla smaragdina* (Fabr.). The general appearance, colour and movements of the spider are so very ant-like that it can pass unnoticed in the midst of the ants, though the ant and the spider are not much alike when examined minutely.

About the protective mimicry of Line-weaving or Orb-weaving ant-like spiders Dr. McCook says:—'Whether or not any ant-like species are found among sedentary tribes I do not know. But it entirely passes my imagination to conceive what possible advantage could accrue to an Orb-weaver, for example from resemblance to an ant. Orb-weavers, and yet more frequently Line-weavers prey upon ants; but it is not necessary that there should be any resemblance to the emmet in order to accomplish the destruction of vast numbers of them, as I can fully testify. As the Orb-weavers and Line-weavers do not leave their snares to capture prey and move among the ants after the fashion of the prowling Saltigrades that do mimic ant forms, the fact of ant resemblance, should it exist among them, must have a quite different solution. One could suggest in their case, a protective value in resemblance to wasps, but none at all as against ants.'[1]

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[1] (a) Hingston, Major R. W. G., I.M.S., F.Z.S., 'Field Observations on Spider Mimics', *Proc. Zool. Soc. Lond.*, ii, p. 844 (1927).

(b) Simon, E., *Hist. Nat. Des Araignées*, Paris, T., ii, p. 502 (1897-1901).

[2] Simon, E., *Hist. Nat. Des Araignées*, Paris, T. ii, pp. 496-505 (1897-1901).

[3] (a) *Ibid.*, Tome premier, p. 986 (1892-1895).

(b) Hingston, R. W. G., *Proc. Zool. Soc. Lond.*, ii, pp. 844-848 (1927).

(c) Kunhikannan, K., 'An Aggressive Mimic of the Red Tree Ant', *Jour., Bom. Nat. Hist. Soc.*, vol. xxiv, pp. 373-374 (1915).

(d) Mukerji, D. D., 'Report on a Collection of Ants (*Tr. oecophyllini* Forel)', *Jour., Bom. Nat. Hist. Soc.*, vol. xxxiv, pp. 157-158 (1930).

The mimicry of this spider to *Oecophylla smaragdina* may not be a case of protective mimicry against the ants, but it seems that this likeness helps to protect them from their natural enemies, viz., spider-eating lizards and birds, etc., as these are always found to keep at a safe distance from the biting red-ants.

Propostira ranii sp. nov.

The length of the female spider is 3.5 mm. Its cephalothorax is somewhat flat and oval-shaped, being longer rather than broad (Fig 1). The thoracic region is somewhat raised and triangular towards the back. The pedicle is very short and slender. The abdomen is truncated at the posterior extremity and much broader than the cephalo-thoracic region. The dorsum appears to be flattened or slightly concave. Down the abdomen, there are two protuberances or hump-like projections, one on each side, presenting a dorso-lateral aspect, with prominent broad black spot at the base of each of them. Further down, at the edge of the posterior extremity there are two more similar protuberances with similar black spots at their bases. Near the apex, the abdomen is rugose with some transverse black linings extending towards the ventral portion. The body is pubescent and brick-red all over with some blackish shades on the cephalo-thoracic region.

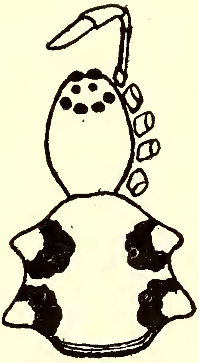

Fig. 1.—Dorsal view of *P. ranii* with 4 humps and prominent black spots.

The eyes, which are eight in number, are arranged in three rows. The anterior row contains the biggest pair of eyes which are projecting forward. The posterior row is procurved and contains four middle-sized eyes. The median row contains the smallest pair of eyes.

Legs are extended more or less in normal fore and aft directions. They are slender and pubescent, the front pair of which is the longest and strongest of all, measuring about 12 mm. The third pair of legs is the shortest while the second and fourth pairs are subequal. All the legs are bright brick-red in colour except the middle tibial and metatarsal portions of the front pair which are pale brown. Tarsal claws are black and two in number without any terminal tenent hairs.

Tibiae and tarsi of the pedipalpi are somewhat swollen in comparison with the rest of the joints. There is one black tarsal claw on each of the pedipalp.

Mandibles are unicate and pluridentate and covered with sparsely distributed black hairs. Maxillae are broad and long exceeding the mandibles and thinly covered with black hairs. They are strongly divergent with the semi-circular labium in between them. The sternum is slightly convex and more or less triangular in shape (Fig. 2).

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[1] McCook, H. G., *American Spiders and their Spinning Works*, vol. ii, pp. 364-365 (1890).

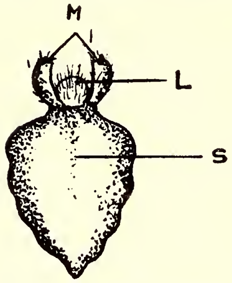

Fig. 2.—M. maxillae, L. labium, S. sternum.

Ventrally, there are some semi-circular folds with black linings on them, around the posterior margin of the abdomen (Fig. 3). The epigynum is very simple, occupying a small space between the pulmonary sacs, with a crescent cup-like atriolum which is swelled in the back. Six spinnerets are seen ventrally and behind them the anal papilla is conspicuous. The anterior pair of spinnerets are broad, sub-cylindrical and thickly covered with short black hairs. The posterior pair is less broad than the anterior pair. In the middle of these two pairs there is a rudimentary pair of spinnerets.

The spider, I collected, spun some irregular lines of thread, covering a small space, to which a pea-like cocoon was attached. The cocoon which I collected along with the spider contained 51 minute eggs which were hatched after 13 days, counting from the date of capture. I have with me a type specimen which has been carefully preserved.

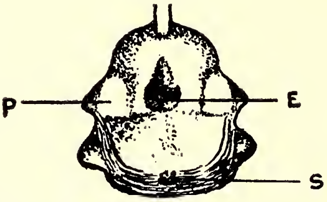

Fig. 3.—Abdomen ventral view. E. epigynum, P. pulmonary sac, S. spinnerets.

Bose Research Institute,
Calcutta.
March 1934.

GOPAL CHANDRA BHATTACHARYA.

XX.—ON THE MATING HABITS OF SPIDERS.

A study of the courtship among Spiders reveals evidence in favour of Darwin's theory of sexual selection. Engaged in collecting spiders, my one hour's attempt among the bushes was rewarded with five spiders. I secured them alive in separate tubes. They all appeared to be of the same species included in the genus *Peucetia*. One of them was a female and the remaining four males. I performed the following experiment:—

I took a conveniently big glass jar and introduced a circular piece of blotting paper into it to cover the bottom. I put the female specimen and one of the males into the jar and closed its mouth. Above the white background, their actions were clearly visible. At first the male remained still. After five minutes he seemed to exhibit some amorous movements of the limbs, but the menacing attitude of the female drove him away to the side of the jar. She did not wait any more but ferociously pounced on him; a contest ensued in which she gained the victory by killing her suitor.

I put another male into the jar. The course and the result were the same as in the previous case, but the battle was longer.

I tried with the third one. He was an active fellow and as soon as he appeared on the stage he stood on his two pairs of hinder legs, lowered his abdomen, elevated his cephalothorax and greeted the female, raising his sexual appendages, front legs and all. She watched him carefully. Remaining in the same posture he glided towards this side and that, always shaking his palpal organs. Then he slowly advanced towards and began to run round and round her, she always turning about to face him. About fifty times he thus encircled her and taking advantage of one of her careless moments, smartly jumped on her and, sat comfortably on her cephalothorax facing her abdomen. He with his front legs embraced her. She did not object to this. The pair remained so for more than an hour but as I had to attend to office work I left them there and wrote these lines.

Why did the female not accept the first two suitors? Why did she allow the third one to mate with her? The only answer is the latter appealed most to her eyes perhaps he danced cleverly. But for his dancing he might have also become her prey. There is a selection of mates in this species and this selection is based apparently on the degree of attractiveness and power of dancing on the part of the males.

Mahim P.O.,
Bombay. T. V. SUBRAHMANAYAM.
August 18, 1934.

XXI.—DO YOUNG SCORPIONS EAT THEIR PARENT?

There is a common belief regarding scorpions in Gujarat that the young scorpions, soon after being born feed upon the mother —the latter voluntarily succumbing to the injury. Is this not too much to expect of a mother of the class of *Arachnida* to wilfully perform such an act of self-immolation simply for furnishing food to her progeny?

The belief is, however, very common and reference to this is found in Gujarati poetry, bestowing praise on the scorpion female for her supremely self-sacrificing behaviour. In this connection it would be very interesting to know from any of the readers of your *Journal*, observations regarding the breeding habits of scorpions, if possible, about a series of generations and particularly about the Indian species.

Burma Forest School,
Pyinmana. M. H. DESAI, B.Ag. (Entomology).
August 28, 1934,

XXII.—OBSERVATIONS ON TERATOLOGICAL INDIVIDUALS OF *APTINOTHRIPS RUFUS*[1] GMELIN.

(*With two plates*).

There are two forms of *Aptinothrips rufus*, the commoner with six-jointed antennae, and the scarcer with eight joints. Priesner[2] found a single case with seven-jointed antennae which he has described as *forma intermedia*.[3] This is important in view of its inter-relationship with the two forms of the species found in Europe and America.

The types of abnormalities in the antennae are classified here under five divisions:—

1. Reduction in the number of joints.
2. Malformation of individual joints.
3. Presence of single median antenna.
4. Fusion of two joints.
5. Presence of normal six- and eight-jointed antenna in the same individual.

1. *Reduction in the number of joints.*—This type of deformity is very common (Pl. I, figs. 1-3 and Pl. II, figs. 5, 6, 9) and the reduction is found in one or both antennae. In Plate I, fig. 1, the left antenna is five-jointed and the right six-jointed and normal. The measurements are:—Right:—*Length* (*Breadth*) 22 (25); 33 (25); 25 (18); 25 (18); 25 (22); 66 (18). Total 192 μ. Left:—22 (29); 29 (18); 18 (18); 22 (22); 55 (22). Total 137 μ. Right normal. Left shorter than the right, first joint normal, second smaller. Joints 1-3 pale yellow concolorous with those of the right side, fourth absent, sixth short and dark.

In Pl. I, fig. 2, right antenna is eight-jointed and normal, left seven-jointed and abnormal. Measurements are:—Right:—22 (29); 29 (25); 29 (18); 25 (18); 25 (18); 44 (18); 11 (7); 14 (3). Total 191 μ. Left:—22 (29); 29 (22); 22 (18); 22 (22); 33 (18); 22 (14); 14 (3). Total 155 μ. Fifth joint large and darker than the right. Sixth short. Seventh absent.

In Pl. I, fig. 3, right antenna is deformed and five-jointed, left normal and six-jointed. Measurements are:—Right:—25 (29); 29 (22); 22 (16); 22 (18); 59 (22). Total 151 μ. Left:—25 (29); 33 (25); 29 (18); 29 (18); 29 (18); 66 (18). Total 196 μ. Fourth absent, sixth shorter.

In Pl. II, fig. 5, left antenna is deformed and right is normal and six-jointed. Measurements are:—Right:—25 (29); 33 (25); 25 (18); 25 (18); 25 (18); 62 (18). Total 192 μ. Left:—25 (29); 29 (22); 18 (14); 29 (25); 18 (11). Total 107 μ. Third joint very

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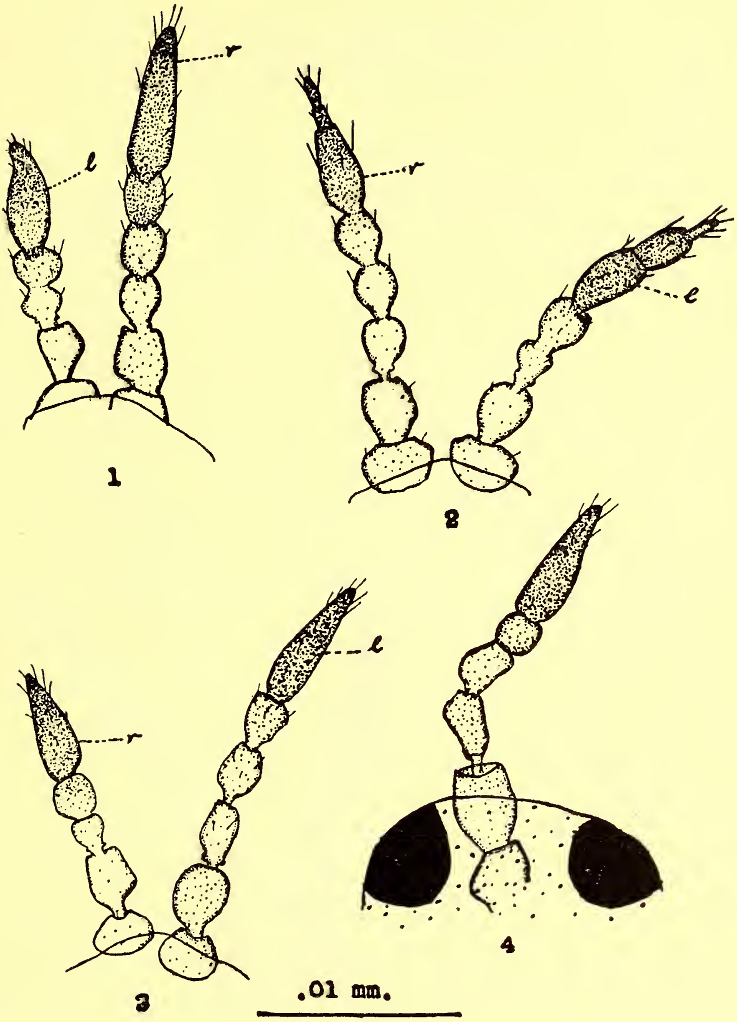
[1] The material was collected at Edinburgh in 1930-1931. I am thankful to Dr. C. B. Williams, Chief Entomologist, Rothamsted Experimental Station, for the use of his collection and papers on thrips while at Rothamsted.

[2] Priesner, H. (1921), Die verschmelzung der Fühlerenglieder bei Aptinothrips rufus Hal (Ord. Thysanoptera) und ihre Ursachen. Kranchers Ent. Jahrb., pp. 162-166, fig. 1.

[3] Priesner, H. (1928), Die Thysanopteren Europas, i.iv, Wien.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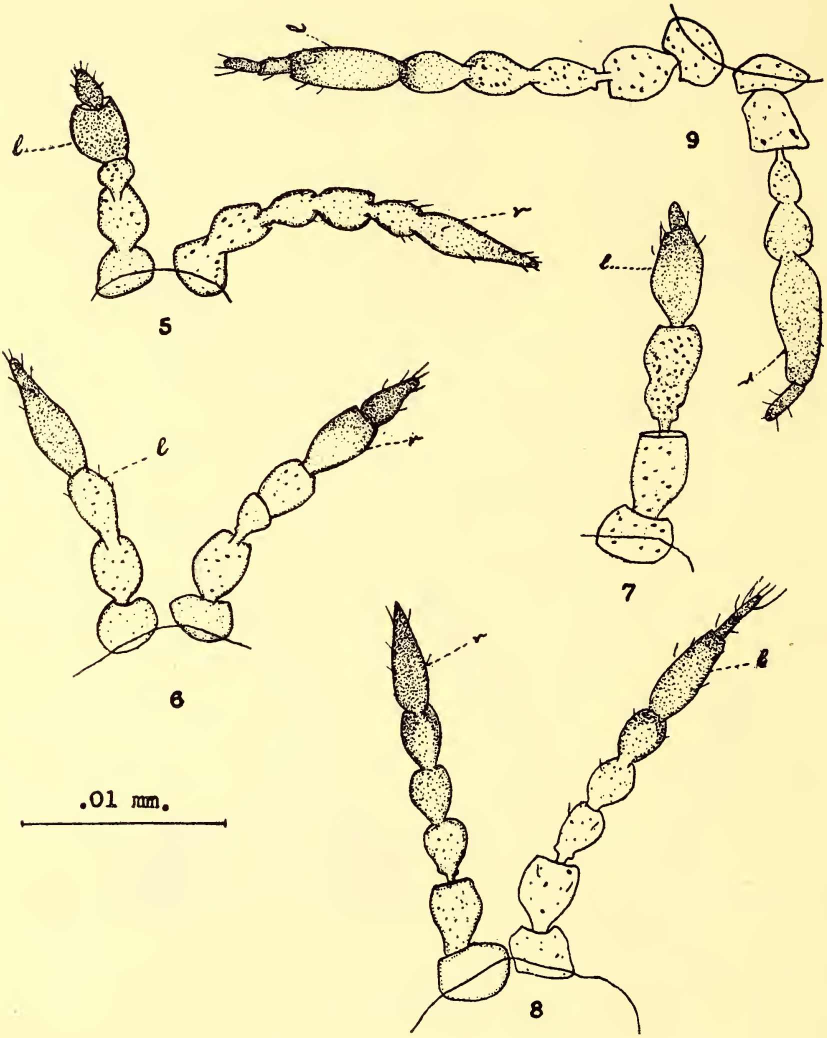
Antennae of *Aptinothrips rufus.*
Text figs. 1-4.

(For explanation see body of note.)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Antennae of *Aptinothrips rufus*.
Text figs. 5-9.

(*For explanation see body of note.*)

small, fourth absent, fifth much swollen and dark, sixth very short and deeply pigmented.

In Pl. II, fig. 6, both antennae are deformed. Left has four and the right six abnormal joints. Measurements are:—Right:—25 (29); 33 (25); 22 (14); 25 (22); 33 (22); 25 (14). Total 159 μ. Left:—25 (29); 37 (22); 37 (22); 62 (18). Total 148 μ. Right antenna six-jointed, third joint short, fifth longer than the normal, sixth much smaller and deeply pigmented. Left four-jointed, third joint absent, fourth much longer, fifth absent, sixth long and appearing normal.

In Pl. II, fig. 9 right antenna is six-jointed and abnormal and the left is eight-jointed and normal. Measurements are:—Right:—22 (33); 29 (25); 22 (14); 25 (22); 59 (22); 22 (3). Total 174 μ. Left:—29 (29); 33 (25); 29 (18); 29 (22); 25 (18); 44 (18); 11 (7); 14 (3). Total 207 μ. First and second joints of the right shorter than the left, third shorter, fifth absent, sixth longer and wider than the normal. Seventh absent. Eighth longer and as wide as the left.

2. *Malformation of individual joints.*—It is seen in most cases (Pl. I, figs. 1, 3 and Pl. II, figs. 5, 7) that reduction or fusion is followed by malformation of joints. The joints are shorter or longer than the normal and some have grotesque appearances. The basal joints are invariably normal.

3. *Presence of a single median antenna.*—In this specimen (Pl. I, fig. 4) no trace of second antenna is visible. Measurements are:—18 (22); 37 (29); 33 (18); 22 (18); 18 (18); 59 (18). Total 188 μ. Basal boundary of the first joint not clear, second joint prominent and large, fourth curved, fifth rounded, sixth deeply pigmented.

4. *Fusion of two joints.*—Occasionally two joints are fused (Pl. II, fig. 7) to make a single joint. In some cases the line of demarcation between the joints is not visible.

5. *Presence of normal six- and eight-jointed antenna in the same individual.*—The presence of six- and eight-jointed antenna (Pl. II, fig. 8) in the same individual was found in a very large collection of eight-jointed forms. Measurements are:—Right:—25 (29); 29 (25); 29 (18); 25 (18); 25 (18); 44 (18); 11 (7); 14 (3). Total 196 μ. Left:—22 (29); 29 (25); 29 (18); 25 (18); 25 (18); 51 (18). Total 185 μ. The right antenna is eight-jointed and the left six-jointed.

Length, breadth and pigmentation of individual joints are almost like the normal ones on two separate forms. It seems very probable that this and the seven-jointed intermediate form (forma intermedia, Priesner) suggests the connection between the two forms of *Aptinothrips rufus* which are distinguished by antennal characters.

ZOOLOGY DEPARTMENT,
AGRICULTURAL COLLEGE,
CAWNPORE.
March 14, 1934.

U. S. SHARGA,
M.SC., Ph.D., F.E.S.

XXIII.—TERMITES AS FOOD.

I have perused the small note on 'Termite Collection in South India for Food' sent to you by Mr. T. V. Subramaniam of the Government Museum, Madras, published as note xxii on p. 498 of your last issue. I may inform the writer that the fact that white ants are edible is not at all new. I am afraid he has not read the previous literature on this subject which is as old as 1779 when the Danish naturalist Dr. Koenig published a very interesting account of white ants in South India. I would advise the writer to peruse a translation of Dr. Koenig's paper by Fletcher in the Report of the Fourth Entomological Meeting, Pusa, 1921 (pp. 301-333). In that paper the learned naturalist gives a very interesting account of termites and also explains how people in parts of Tanjore catch termites for food and Fletcher also gives photographs of the methods adopted in parts of Coimbatore. Catching of winged termites (*Easel*) for food is quite a common thing in all parts of South India.

Agricultural Research Institute,
Coimbatore. T. V. RAMAKRISHNA AYYAR, B.A., Ph.D.,
September 15, 1934. *Offg. Government Entomologist.*

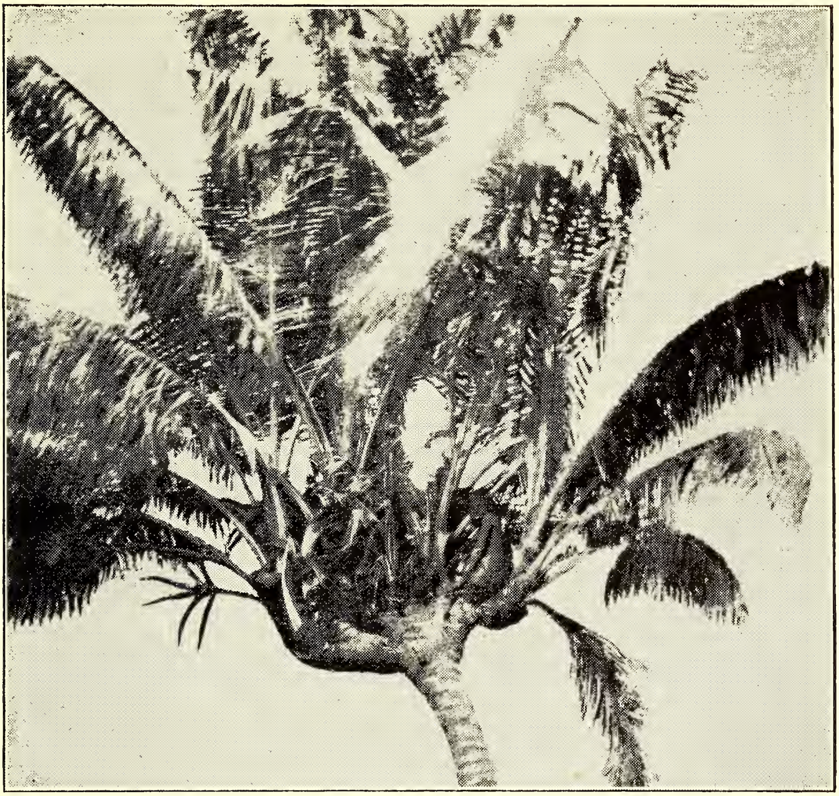
XXIV.—STEM FASCIATION IN THE COCOANUT PALM (*COCOS NUCIFERA*, LINN.).

(*With a photo*).

Many instances of stem fasciation in dicotyledonous plants are on record (1, 2 and 3) while in monocotyledonous species, the phenomenon is apparently rare.

An interesting specimen of stem fasciation in the cocoanut was noted by the author in June 1932 in a garden near Erode, Coimbatore District (*Vide* photograph). The tree is about 20 years old and appears to have had quite a normal growth up to the time of fasciation. Above the normal trunk of about 25 ft., the stem flattened and seven growing points appeared and began to develop in one plane. The first leaves were plaited like those of coconut seedlings. These leaves, however, soon became normal pinnate ones with distinct leaflets. There are six healthy branches as seen in the photograph. The position of a dead branch is where a boy is seated.

The exact cause of the phenomenon is not known. The usual causes producing stem fasciation, viz., super-abundant nutrition and diseases do not seem to hold good in this instance. The garden was quite an ordinary one and no special treatment was given to the tree. There was no evidence of any disease.



Stem fasciation in the Coconut (*Cocos nucifera,* L.).

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1. C. Tadulingam and K. Cherian Jacob, *Journal of the Indian Botanical Society,* Vol. iv, No. 6 (1925), pp. 225-226.
2. W. C. Wordsell, ? , Vol. i, p. 111.
3. O. Penzig, *Pflanzen-teratology*, p. 439.

K. CHERIAN JACOB, L.Ag., F.L.S.

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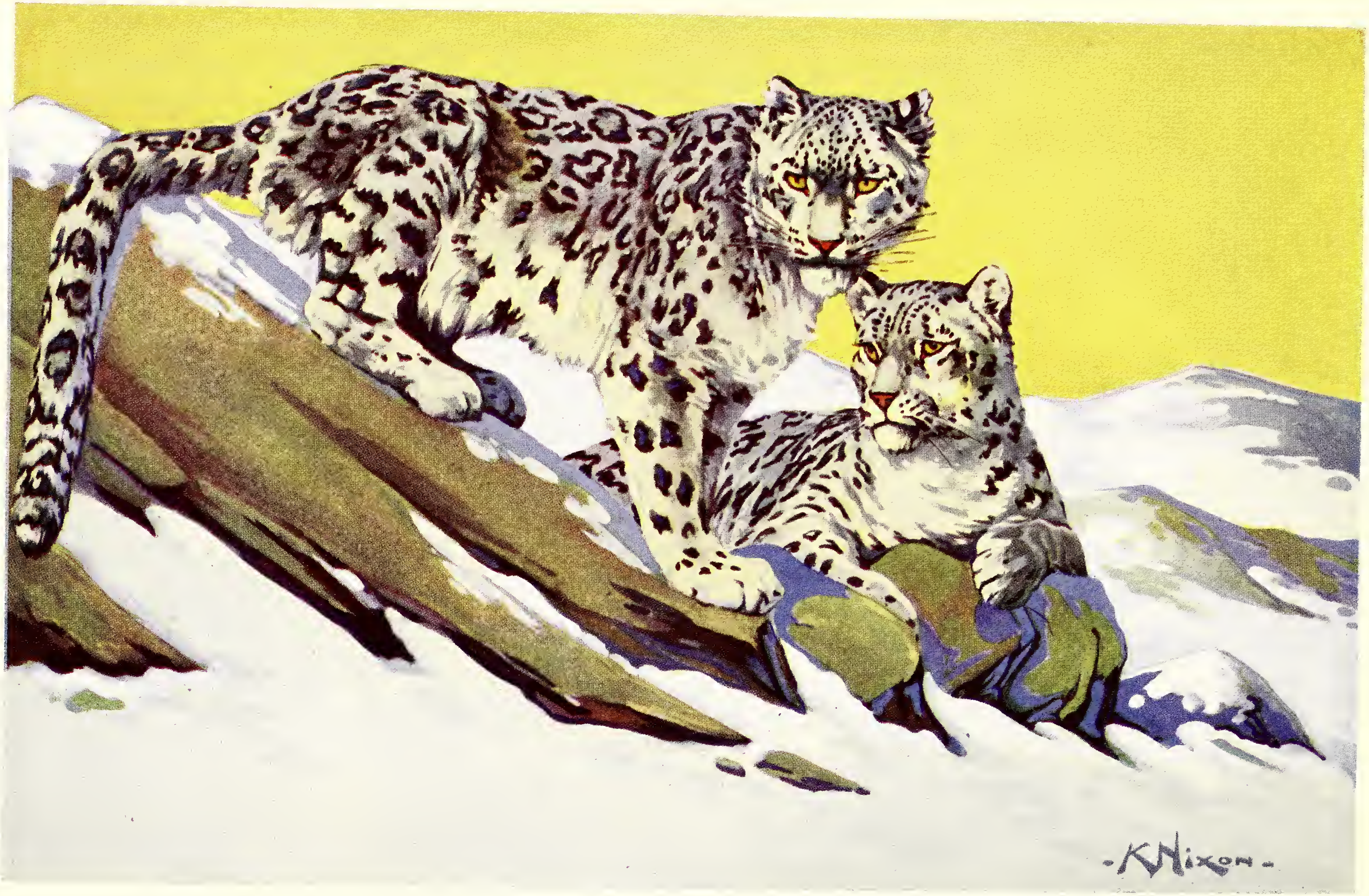
THE WILD ANIMALS OF THE INDIAN EMPIRE

AND THE

Problem of their Preservation

Part III.



SNOW LEOPARDS.

THE WILD ANIMALS OF THE INDIAN EMPIRE.

PART III.

CARNIVORA OR BEASTS OF PREY.

The Carnivora or flesh-eaters is a name given to a distinctive group of animals known familiarly as 'Beasts of Prey'. The assemblage includes the cats, great and small, and such varied animals as civets, dogs, bears and the weasels and their numerous kindred. It also includes the aquatic beasts of prey—seals, sea-lions and walruses.

Not all these animals are exclusively or even mainly flesh-eaters. Some live partly on vegetable food. Again, many mammals not classed as carnivores feed on flesh. The Australian Dassyures, creatures not much bigger than a cat with the predaceous habits of weasels are wholly carnivorous. But they, like the well-known kangaroo, are broadly distinguished as Marsupials or 'pouched' animals. With this exception it might be said that there is no group of mammals which feeds so generally on flesh.

The Carnivora as a whole reveal in their structure certain characters which are common to all of them and which mark them as animals whose particular role is the capture and destruction of living prey. The evidence of a predatory life is most signally revealed in the structure of their teeth and claws—essential weapons designed to secure for the beast of prey its appropriate food. Very striking in the skull of a carnivore are the canine teeth. The majority of mammals have canine teeth, but in carnivores the canines tend to become larger and stronger than the incisors and in some of the great cats these teeth are represented by enormous offensive fangs. Their special purpose is the seizing and holding of prey. All carnivores have 6 incisors. Usually, the outer incisor in the upper jaw is the largest and sometimes it is so large and pointed that it looks like a small canine. Canines and incisors provide the beast of prey with appropriate weapons for seizing, holding and biting. The mastication of food is the work of the cheek or molar teeth. Among carnivores there is much variation in form and structure of the molar teeth—variation which is related to some extent to the degree to which a particular animal is or is not wholly carnivorous.

Apart from the teeth, the most distinctive feature in the skull of a carnivore is the mode of articulation of the lower jaw. It is connected to the skull and moves on a small transverse hinge. The device gives strength to the joint but deprives the animal of the power of moving its jaws from side to side or backwards and forwards. Movement is limited to an up and down biting or snapping action, and the grip of the jaws is intensified by the great biting muscles which secure the lower jaw to the skull. Strong cheek arches and ridges have been developed in the skull to provide an attachment for these muscles.

All the carnivores have never less than four toes on each foot and these are generally armed with strong sharp claws. The clavicle or collar bone is frequently absent in beasts of prey. This is a feature which they share with hoofed animals. When present, it never forms a complete connection between the breast bone and the shoulder blade. It is reduced to a splint of bone embedded in the muscles of the chest. The brain of a carnivore is well developed and the stomach is always simple.

These are some of the characters which distinguish carnivores from other mammals.

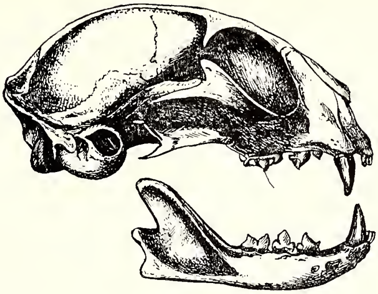
In themselves they form a varied assemblage in which two great divisions are recognised. One includes the terrestrial and the other the aquatic Beasts of Prey.

Seals, walruses and sea-lions form the latter group. Descendants of land-dwelling carnivores, as a result of subsequent development into animals whose element is the water, they have undergone many changes in form and structure and have lost some of the main features which distinguish their terrestrial relatives. The name *Pinnipedia* or 'fin-footed', by which this sub-division of the Carnivores is known, describes the condition of their hands and feet which have been modified into flippers. Mainly inhabitants of cold seas, none of these animals is found in India.

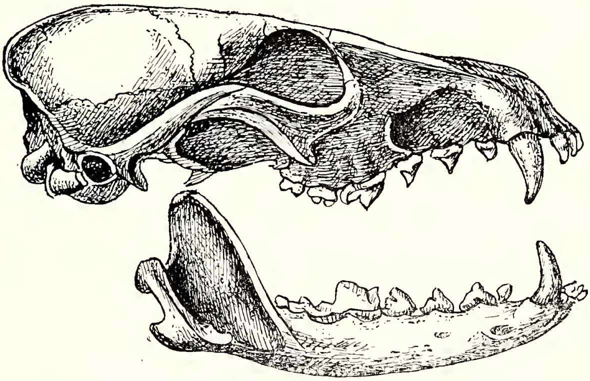
The terrestrial Beasts of Prey are called *Fissipedia* or 'free-footed', in allusion to their distinct and separate toes which are never encased in skin to form a fin or flipper.

As organs of locomotion the limbs are not swimming but essentially walking, running or climbing organs. Walking is effected either on the entire sole of the foot as in the bears or, as in cats and dogs, mainly upon the toes with the hinder part of the foot held clear from the ground. A somewhat intermediate mode of walking is found among weasels, otters and badgers. Most carnivores are good climbers. Some live almost entirely in trees.

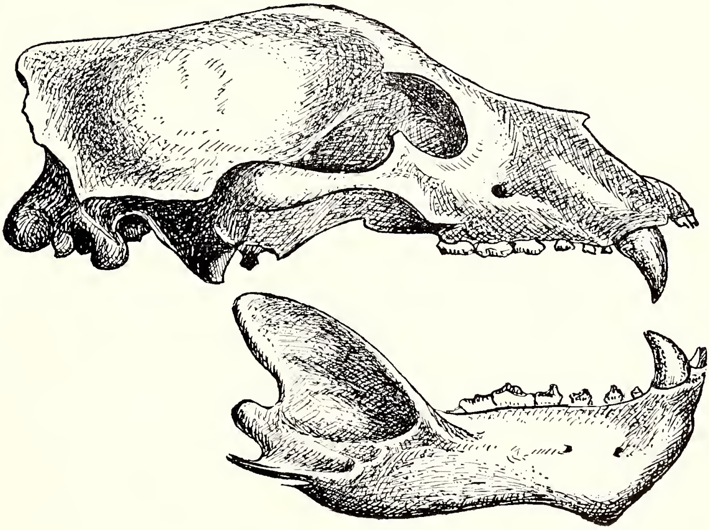
Terrestrial beasts of prey display a varied and highly developed armament of teeth. While the canine and incisor teeth of various species are on the whole tolerably uniform, the molar or cheek teeth display numerous and interesting variations. A reduction in the number of cheek teeth and the compression of their crowns into narrow cutting edges generally indicate an exclusive diet of flesh. While the more numerous the cheek teeth and the broader their crowns, the more likely it is that the owner subsists on a mixed diet. Extremes of these two types are seen in the cats and the bears—one wholly carnivorous the other mainly herbivorous; while stages between the two may be traced through other forms of Carnivora. A striking peculiarity in the molar teeth of beasts of prey is the development of a carnassial or 'flesh-tooth'. In the majority of families it is larger than the other cheek teeth. The flesh tooth in the upper jaw is always the last premolar—its antagonist in the lower jaw is the first true molar. The crown of the upper flesh tooth consists of two parts, a sharp edged blade divided by notches into two or more cusps borne upon two inner roots and the 'tubercle' a short blunt cusp supported by a separate root. In carnivores which are purely flesh feeders—the flesh



Domestic Cat.



Common Fox.



Sloth Bear.

SKULLS OF CARNIVORES.

To show variation in the number and form of cheek teeth

tooth is conspicuous—its blade well developed and its 'tubercle' reduced in size. An increase in the tubercular character of the tooth is usually traceable through those genera which are mixed feeders. In bears, the flesh tooth is scarcely distinguishable from the other cheek teeth. The lower flesh tooth varies in form. In cats, its crown consists solely of a blade which is divided into two large pointed cusps. Behind these cusps there is a small rudimentary third division. The opposing blades of the upper and lower flesh teeth work against one another with a scissor-like action. They provide the mechanism for shearing flesh from bones or crushing hard food. Generally the molars in front of the flesh tooth are sharp pointed and compressed, those behind are broad and tuberculated.

With the exception of Australia and New Zealand, the Carnivora inhabit all the countries and larger islands of the Globe from the icy oceans of the Arctic Circle to the tropical plains of India and Africa. Some, like cats and dogs, have a world-wide distribution; others, like the hyaenas and civets, are restricted in their range. In the earliest part of the Tertiary epoch there were numerous Carnivores small and large. Their skulls were much like those of existing Carnivora. They had cutting teeth and clawed feet. The brain was small. They are now grouped in a distinct sub-order—the *Creodonta*. Some of them were the ancestors of modern Carnivores. Others have left no descendants. In habit and general appearance these primitive carnivores were like the modern beasts of prey—but the various distinctive features of the modern races are found in these ancient forms in different combinations.

Various carnivores related to the modern forms lived during the latter part of the Tertiary period. Perhaps the largest of them were the Amphicyons. Classed among the dogs, the amphicyon equalled the biggest bear in size and revealed in its structure some affinity to these animals. A survivor of this archaic animal lived in the Siwaliks. These mountains were also the home of two species of sabre-toothed tigers (*Machærodus*) representatives of a family of extinct cats. The sabre-toothed tiger had enormous upper canines. They took the form of great slightly curved compressed fangs with serrated edges. The jaws were loose hung and could be opened wide enough to allow full play for the action of the tusks and so allow the powerful muscles at the back of the neck to drive them down vigorously into the body of an enemy.

The modern land Carnivora are divided into three sections, the distinctive characters between them being derived mainly from difference in the structure of the base of the skull. These sections are: (1) the *Aeluroidea* or Cat Section; (2) *Cynoidea* or Dog Section; and (3) the *Arctoidea* or Bear Section. Each of these three animals the cat, the dog and the bear provides the pattern of its group.

The Cat group or *Æluroidea* includes the cats, civets, mongooses and hyaenas. The Dog group, *Cynoidea*: dogs, jackals, wolves and foxes. The Bear group, *Arctoidea*: bears, badgers, racoons, martins and weasels.

ÆLUROIDEA: Cat Section.

Family I. *FELIDAE*: CATS.

The Cats, great and small, though they vary much in size and habits, form a well-marked tribe with characters which distinguish them from all other Carnivores. Splendidly equipped for their role in life, they represent the Beast of Prey in its perfection. The Cats are supreme in armament of tooth and claw, in their combination of grace, strength and agility.

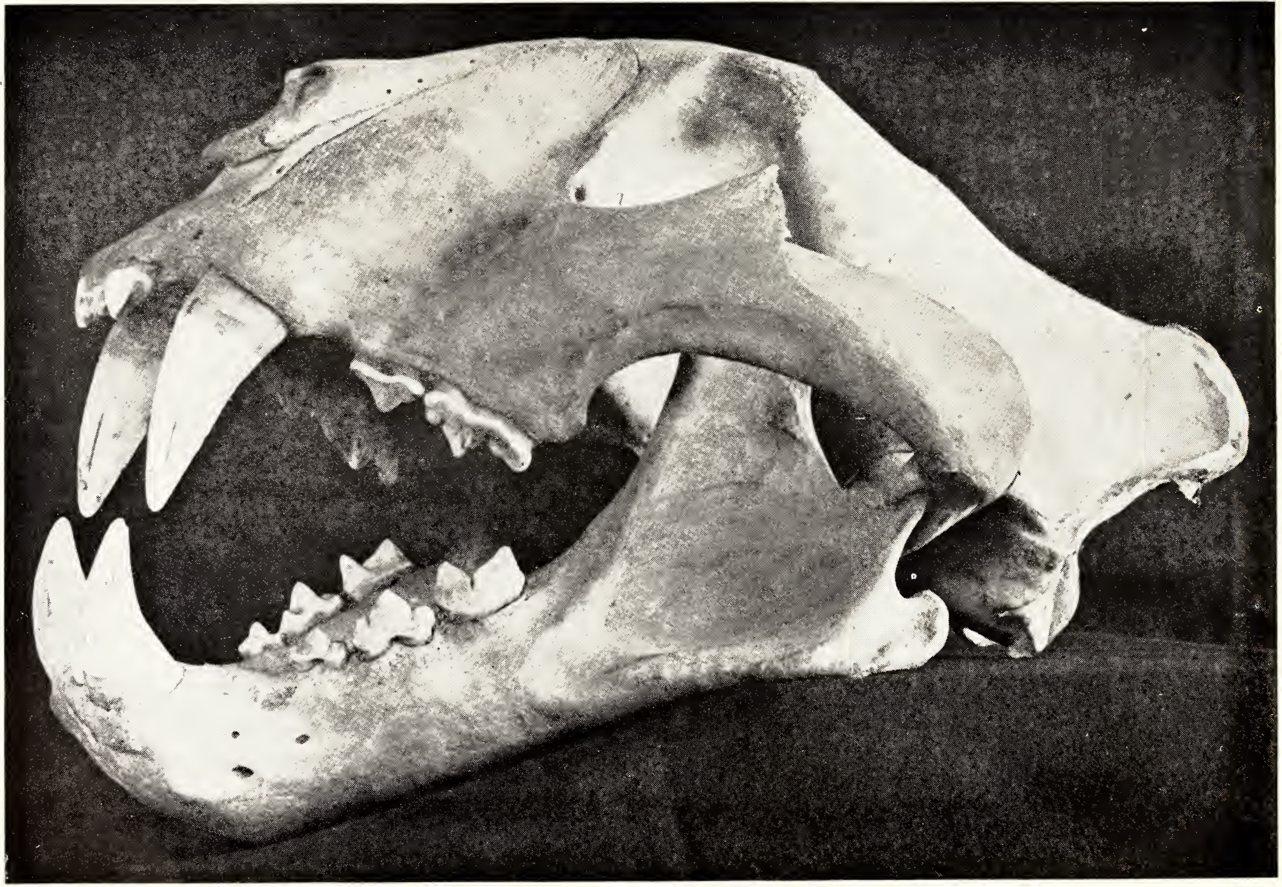
None of the Beasts of Prey display so powerful a development of teeth as some of the great cats and in none are the teeth so perfectly adapted to a purely carnivorous diet. Increased sturdiness and strength has been attained in their jaw bones by a reduction in their length. The comparative shortness of the jaws in relation to the length of the head gives the Cats that flatness of feature which contrasts so markedly with the pointed muzzles of civets or the long snouts of dogs and bears.

With the shortening of the jaw bones there has been a corresponding loss in the number of cheek teeth. Cats have much fewer cheek teeth than dogs or other more generalised forms of carnivores. Speaking generally, an exclusive diet of flesh is indicated by a level row of small pincer-like incisors, by large, deeply implanted and widely separated canines and lastly by a reduction in the number of molar teeth—the normally broad grinding crowns of those that remain being compressed into sharp-edged cutting implements.

This is a condition seen in its most perfect form in the teeth of cats. A modification in the number and shape of their teeth has been effected in early stages of their evolution by those processes which adapt the structure of a creature to its specific needs. A study of the teeth of primitive and now extinct forms of cats shows that the perfecting of their dental armament has been arrived at by stages. Firstly there was a reduction in the number of cheek teeth, followed by an enlargement of the canines which took their conical form and finally came the modification of the cheek teeth into purely cutting instruments.

In existing cats the first cheek tooth in the upper jaw is small or sometimes absent. The second cheek tooth shows a sudden increase in size. It is a large and sharply bladed tooth. The third tooth displays even greater gain in strength and size. Its crown is divided by two notches into 3 sharp pointed blades. This is the upper carnassial or 'flesh tooth'. It is the last premolar in the upper jaw. Tucked away behind this great tooth and set transversely to it is the solitary surviving molar. From its size and position it can be of little significance in mastication.

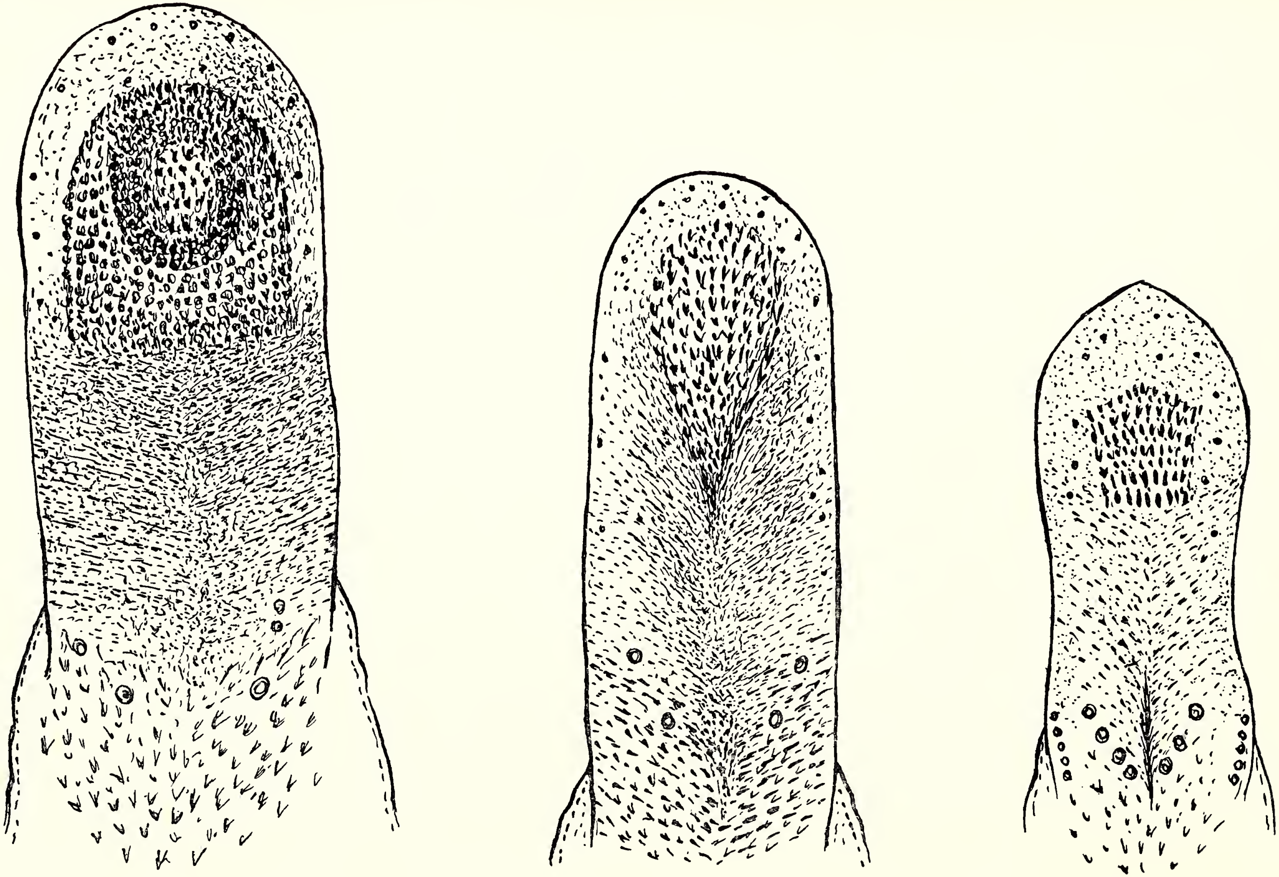
Of the three cheek teeth in the lower jaw the first two are premolars, and third and last tooth is a true molar. It is divided by a V-shaped notch into two blades. It functions as the lower 'flesh tooth'. The peculiar articulation of the lower jaw to the skull which is characteristic in beasts of prey prevents a circular grinding action and confines the play of the cheek teeth to a ver-



SKULL OF A TIGER.

Note the enormous widely separated canine teeth, the few blade-like cheek teeth, supported on short powerful jawbones and the sturdy cheek arches which help to provide attachment for the great biting muscles.

TONGUES OF "CATS".



TIGER (*Pantherinae*). CHEETAH (*Acinonychinae*). CARACAL (*Felinae*).

The sharp-pointed conical papillae tend to form a "spinous patch" on the fore part of the tongue. The proximity of this patch to the apex of the tongue, its posterior limits, the shape of the spines are distinctive on the 3 subfamilies in which the Cat tribe is divided. (Dr. C. F. Sontag, P.Z.S, 1923).

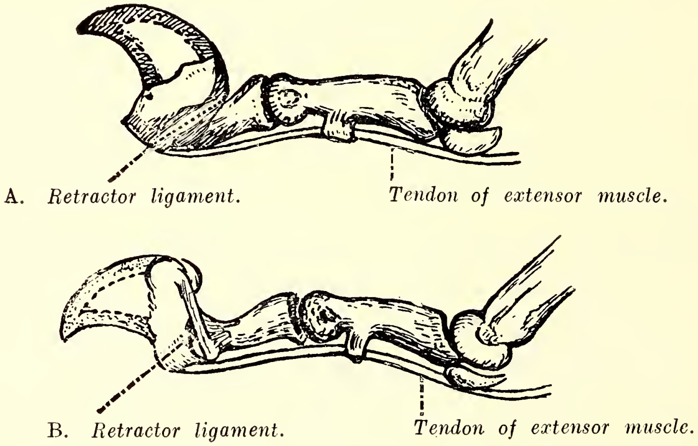
tical up and down movement in which their compressed and sharp edged crowns working against one another cut and coarsely divide the flesh. The deep rooted trenchant and sharp pointed canine teeth are well adapted to hold, to pierce and lacerate struggling prey. We have referred to the reduction in size or complete suppression of the first cheek tooth. This leaves a space between the molars and canines. Thus, the great canines which interlock in the closed jaw stand clear when the jaws open and are driven full into the flesh of a victim. There are no contiguous teeth to obstruct their complete penetration.

There is a level row of 6 small pincer shaped incisors in the upper and lower jaw. Their purpose is to gnaw the soft gristly ends of bones and scrape off the tendinous attachments of the muscles. The array of sharp incisors, the powerful canines, the blade-like molars, have their special function and each is perfect for its special purpose. This armament of teeth supported on short powerful jaws controlled by great biting muscles, for whose attachment special provision has been made in the wide sturdy cheek arches and the bony crest of the skull, complete the Cat's formidable equipment for the killing and ingestion of its prey.

But carnivorous animals which tear to pieces and swallow their food can scarcely derive much enjoyment from its taste. It is only in Man and those herbivorous animals which prepare their food by mastication that the sense exhibits much delicacy of perception and the tongue attains a perfect adaptation to this end. In the Cats the mechanical function of the tongue predominates over the sensitive. Numerous papillae which cover the tongues of animals make them rough to the touch. In cats this roughness is greatest. These lingual papillae are of three types. In the Cats those which function as organs of taste are reduced to small dimensions. They are scattered about the surface of the tongue and are more abundant on its margins. Most numerous and prominent are the 'conical papillae'. In cats these conical papillae are encased in horny, pointed sheaths which stick into one's fingers like so many pins. Their function is purely mechanical. Their numerous sharp and rigid points give the tongue the action of a rasp. Bones are not usually crushed and swallowed by cats. They are licked clean and left and the rasp-like tongue is well adapted to remove the remnants of flesh which adhere to a bone. In the Cats the conical papillae tend to form a 'spiny patch' on the fore-part of the tongue which is surrounded by a zone of smaller papillae. The proximity of or the distance of this spinous patch from the apex of the tongue, its extent, the shape of the spines which form the cluster, are distinctive in certain groups of cats. A study of the lingual papillae in the Felidae, their character and arrangement has offered a means of throwing fresh light on the relationship of the different species.

Like the teeth, the strongly curved claws of cats reveal a perfection of development unequalled by other carnivores.

A beautiful and peculiar provision is seen in the structure of the foot whereby the claws are kept constantly sharp and are never worn down by contact with the ground. The terminal or claw bearing joint is so articulated that in its normal position it lies folded back on or against the preceding joint. In this reverted, partly erect position the claw at its summit is raised off the ground. An elastic ligament holds the joint erect and the claw is received into a sheath of skin specially devised for its reception. When the animal springs upon or strikes at its prey, a tendon clamped to the undersurface of the terminal joint and connected to the great flexor muscles of the limb pulls upon this joint and draws it from its reverted position downwards and forwards. The claws emerge from their sheaths and are bared for action.



Bones and tendons of toe of the Cat. A, claw retracted and held erect by retractor ligament. B, claw extended, pulled downwards and forwards by extensor tendon.

How far the sheaths protect the claws depends upon two factors, the extent to which the claw-bearing joint can be drawn backwards and the length of the sheaths themselves. The Cheetah or Hunting Leopard is often described as having imperfectly retractile claws. A cheetah has the mechanism for retracting its claws and can draw them back as well as some species of cats, but the constantly bared condition of its claws is due to the rudimentary condition of the claw sheaths. These claw sheaths are by no means equally developed in all the Cats. In their most elaborate form as seen in the Lynx, the Tiger or the Leopard, the pollex or thumb is enveloped in a hood-like sheath and the lobes of the sheaths protecting the other claws are large enough to completely enfold them. In some of the smaller cats on the other hand the lobes of the sheath are not equally developed on all the digits and some of the claws are not completely covered—a condition not far removed from that of the civets. Between these two extremes every gradation in the development of the claw sheaths may be seen in cats.

Let us now consider movement in cats and their faculties of sight, scent and hearing—means by which they hunt their prey.

All cats are digitigrade. They walk on their toes and not upon the palms or soles of their feet. When walking the hinder part of the foot is entirely raised from the ground the weight of the body is taken by the toes—but not by the tips of the toes as in hoofed animals. This mode of progression is an improvement on the flat-footed gait of bears or of those carnivores which walk partly on their toes and partly on the soles of their feet. It makes for greater agility of movement.

A cat has five toes on its fore-foot and four on its hind. The innermost toe of the fore-foot, the pollex, corresponds to the thumb of the human hand. It is placed at a much higher level than the other toes and is of little use when walking. The missing toe in the hind-foot corresponds to the great toe of the human foot.

Soft pads under the toes and a broad cushion-like pad under the ends of the bones on which the foot rests when walking help the cat's stealthy movements. Its sinuous supple body, its muffled tread, its gliding progress, brought about by a simultaneous movement of the limbs on each side—concur in effecting a noiseless approach to its prey.

Cats have the largest eyes of all the carnivores. A well developed system of muscles within the eye contracts the pupils in bright light and protects the eyes from glare and by dilating them in darkness allows as much light as possible to enter the eye and so improves its vision. The form taken by the contracting pupil differs markedly in the great and small cats. In domestic cats and in the smaller species generally, the pupil contracts to a narrow slit with two pinholes at each end through which alone the light enters. In the larger felines the contracting pupil takes a circular form.

It is generally agreed that when hunting the sense of smell is the dominant factor in dogs, in cats it is the sense of vision. It is suggested that the flat muzzle characteristic of cats leaves less space for the development of the nasal membranes which have greater scope for development in the longer muzzles of dogs, wolves and foxes. The relative development of the faculties of sight and scent appears to differ in various species of cats. The consensus of opinion is that the Tiger and the Panther display great acuteness of vision and, unlike the Lion, a corresponding dullness in their sense of smell. It is frequently held that these two animals depend mainly on sight and hearing when hunting. But it is difficult to conceive that animals which hunt under cover of darkness do not make the fullest use of both the faculties of sight and scent when seeking their prey, particularly in forest where vision may be circumscribed. At present we have only the vaguest knowledge as to how far purely nocturnal animals depend on vision for obtaining their food. This is one of the reasons why it is so difficult to arrive at any definite conclusion as to the real value of 'concealing' colours in nocturnal animals.

It is believed that a pattern of spots and stripes—so common in the colouration of the cats—is protective. The variegation of tone breaks up the mass of the body, obscures its contours and so helps to conceal it. This is a common explanation of the purpose of markings in tigers, leopards and other beasts of prey. But a patterned hide, if useful to the hunter, would be equally useful to its quarry. Many species of deer which are the accustomed prey of great cats are uniformly coloured when adult, whereas a concealing pattern on their coats would have proved a useful factor in evading detection. Now, if a spotted condition of the young is taken to indicate the primitive colouring of the parents, then the majority of deer are descendants of striped or banded ancestors and pattern in these animals has since been discarded—at least in the colouring of the adults of most species. This suggests that in these animals its significance as a factor in the struggle for existence could have been of no great importance.

Again, the absence of stripes and spots in the lion and other carnivores places them at no disadvantage in securing their prey. Like the tiger, the lion hunts in shadowy forest, in open bush or in grassland and it is claimed that in the African reed beds—a favourite hunting ground of lions—a vertically striped coat would have provided an ideal concealing pattern.

While a variegated colouration may prove a factor in the protection of lesser and more sedentary creatures; it cannot be regarded as essential to the equipment of a beast of prey. Cats, great and small, owe their ascendancy to their perfect mastery over the craft of hunting. Strong and active, of high intelligence, they display a perfection of senses and bodily organism which gives them mastery over creatures in which a ceaseless struggle for existence has perfected the means of escape.

As with all animals the ground colour of the cats varies with environment. There is the change from the light drab tones of desert species to the rich dark colouration of those living in more humid forests. The law of assimilation of colour to environment is more or less constant in Nature. Hazardous deductions of its purpose may lead us into beliefs which are at variance with evidence revealed by the actual lives and habits of animals.

The pattern of different species of cats is in general constant. Individual variations occur. Stripes sometimes break up into spots and spots show a tendency to run into stripes but as a general rule each species breeds true to its local type and there is little change in pattern except perhaps in its accentuation, lightening or obliteration with age. The lion and the puma are uniformly coloured when adult, though spotted or striped when cubs, which is taken as an indication of their descent from striped or spotted ancestors. There is a theory that there have been definite stages in the evolution of stripes and spots in the Felidae. The theory assumes that in the primitive condition, the stripes were longitudinal—a condition now common in the civets—next of kin to the cats. In the second stage the longitudinal stripes broke up into spots. Many civets and some cats again exhibit this pattern. It is perhaps also illustrated in the pattern of the Spotted Deer—the linear arrangement of the spots on its lower flanks suggests longitudinal stripes which have broken up into spots. In the third stage the spots reformed into vertical stripes such as one sees in the tiger, in the banded civet and in certain antelopes. The patternless hide of the adult lion or the puma is taken as the culminating phase in the evolution of markings. If this theory is correct then the progenitors of the tiger were longitudinally banded animals whose descendants passed through a spotted stage and finally attained the transverse stripes of existing tigers. The oblique direction of the stripes on the hind quarters and other parts of the tiger's body, the curious variations in their markings where spots crop up between stripes or stripes tend to continue as faint spots or to double up into loops or the rudiments of a 'rosette' are taken to lend support to this theory. Again the curious variations sometimes exhibited by lion cubs in which spots show a tendency to fuse into stripes, are also quoted as supporting evidence.

To sum up the distinctive characters of Cats as a tribe. There is the shortening of the muzzle—the reduction in the number of cheek teeth, the powerful development of the canines and flesh teeth, the strongly curved retractile claws. These are characters which mark them as a natural and distinctive group of animals. But it has been the contention of zoologists during the last half century that the comprehensive genus *Felis* in which all cats great and small were included required regrouping into several distinct genera. Various attempts to do this have been made by naturalists. The most recent is by Pocock. His purpose was to indicate more clearly the true relationship of different forms of cats and to dispose of such fictitious groupings as imply a close relationship between the Lion and the Puma or give an erroneous impression of the relative affinities of such creatures as the tiger, the domestic cat and the lynx. He based his classification on the variations which are apparent in the structure of the hyoid apparatus in different forms of cats, on differences in the form of the feet and the cutaneous sheaths guarding the claws. He divides the family Felidae into three well-marked groups:

(i) The *Pantherinae* which comprises the Lion, the Tiger, the Panther, the Jaguar and the Ounce.
(ii) The *Acinonychinae* the Cheetahs or Hunting-Leopards.
(iii) The *Felinae* which includes the Puma, the Lynx, and all the smaller cats.

As regards the scientific names of different species, many have received more than one name from naturalists and the tracing of the correct name from the tangle of zoological literature is a matter of no small difficulty. Here again we have followed the nomenclature adopted by Pocock in his recent papers on Felidae which include a careful revision of the synonymy of the various species with which they deal.

With the exception of the Australian continent and Madagascar—the range of cats is universal—the headquarters of the tribe is the Old World. Sixteen different species occur in India and its dependencies, a larger concentration than is to be found in any tract of similar size on the Earth's surface. Of the cats living within our borders during past geological epochs, more than 7 species are known, some similar to existing forms others now extinct. Among them was *Felis cristata* which was quite as large as the tiger and two extinct species of sabre-toothed tigers (*Machœrodus*) one peculiar to India.

Sub-family: I. *PANTHERINAE.*

The Lion, Tiger, Leopard, Jaguar and Ounce.

While most cats, particularly the larger species, are readily distinguished by their form, colour or size it is less simple to discover among them differences in anatomy which offer a clue to the true affinities which exist between the different members of the tribe—distinctions which would help us to discriminate between closely related forms and those which reveal a lesser degree of kinship. Perhaps the most striking variation in the internal anatomy of cats is to be found in the mode of attachment of the hyoid apparatus. It is perhaps an obscure detail in the structure of cats but the mode of attachment of the hyoid has an influence in some way on the voice of the animal—on the power and variety of tone it can produce. Now a similarity of voice is considered nearly always a good indication of affinity among animals. Resemblances or differences in the structure of the hyoid therefore provide evidence which is useful in the classification of the felines. In the lower Vertebrates, in fishes for example, the elaborate hyoid apparatus is importantly connected with the respiratory function, but in mammals it is reduced to a much simpler condition. The apparatus, usually composed of a number of small bones, is named *Hyoid* because of the arrangement these bones in the shape of an arch or of the Greek letter Y. In mammals the arms of the hyoid are suspended from the posterior part of the skull to provide a support for the root of the tongue and for the larynx i.e. the extended part of the wind pipe which contains the vocal chords. The apparatus comes away when the soft parts of the skull are removed. In the smaller cats arms of the hyoid are composed of an uninterrupted chain of small bones which hold the larynx close to the skull and so restrict its power of movement. In the great cats—in the lion, tiger, panther, jaguar and ounce—the arms of the hyoid are imperfectly ossified. In the lower part the small bones are replaced by elastic ligaments. In the lion these tendons may be 6 in. long and may stretch to 9 in. The elasticity given to the hyoid by these tendons allows greater mobility to the larynx. It is not drawn up close to the skull but is embedded in the mobile muscles of the throat. The difference in the mode of attachment of the hyoid seen in the great and smaller cats has resulted in those differences in voice which is so noticeable among them.

The lion, tiger, leopard and jaguar are able to roar but are incapable of purring; while the cheetah, the puma and the smaller cats, whose hyoid is differently constructed, do not roar but can express contentment by purring. Though the roars of the great felines are more or less distinguishable there is an underlying distinctiveness in the power and variety of sounds they produce which is due to the distinctive structure of the hyoid. It differentiates them from the other cats and offers an indication of their affinity to one another. Evidence of relationship between the great felines is also traced in a similarity of pattern in the cubs which may be taken as a specific character. The lion shows a pattern intermediate between the tiger and the leopard and the leopard in its markings shows a definite affinity to the jaguar. The ounce because of similarity in the structure of the hyoid is likewise included in this group of cats. The affinity between these animals is also indicated in a similarity in the position, extent and nature of the conical papillae which form the 'spinous' patch on the surface of the tongue, to which reference has already been made. In the great cats the patch commences near the apex but does not extend to the middle of the tongue. It is a condition which does not occur in the tongues of other cats and provides further evidence of structural kinship between these great felines.

THE ASIATIC LION (*PANTHERA LEO PERSICA* MEYER).

The racial name *persica* is given to lions found in India, Persia or Mesopotamia. One species of lion inhabits both Africa and Asia, but minor differences, more or less constant, are considered sufficient to indicate a racial distinction between Asiatic and African lions. These distinctions do not always hold when individuals from the two countries are compared. They can only be regarded as average differences.

On the average, the Indian lion has a scantier mane than the African and, curiously enough, in combination with this character a fuller coat, a longer tassel of hair at the end of the tail, a more pronounced tuft of hair on the elbow joints and a fuller fringe of hairs on the belly. In size, there is little to choose between the two. The average length of African and Asiatic lions is a few inches over 9 ft. The largest recorded measurement of an Indian lion is 9 ft. 7 in., of an African lion 10 ft. 7 in.

The colour of the lion is tawny. The density of the tone varies in different individuals. Some lions are deep yellowish brown, others are pale, in others again the prevalent tone is sandy grey. Dark tips to the hairs may give the coat a finely mottled effect.

The cubs are spotted and striped. The pattern is taken to indicate descent from a progenitor with markings midway between the spots of a leopard and the stripes of a tiger. The markings fade with growth though an indication of them may be seen in well-grown animals. The colour of the mane may differ little from the tawny tint of the body or it may be more or less sharply differentiated by a lesser or greater intermingling of brown or black hairs. A predominance of black hairs in the mane gives rise to the term 'black maned' lions. Both light and dark maned lions with intergradations between the two may be seen in India though 'black' manes are rare. The mane of the lion begins to grow at 3 years and is said to be complete in about 6 years.

Fully and poorly maned lions are found in India as in Africa. Luxuriance or scantiness of mane is probably an individual character; some animals being more hairy than others. The average scantiness of mane seen in the Indian lion is certainly not due to the mane being 'combed' out in the thorny forests in which these animals live in this country.

The Gir Forest, lying within Junagadh State covers nearly 500 square miles of rugged undulating country. It is composed mainly of stunted teak trees, palas, jambul, babul and bhor, and patches of small bamboo with an undergrowth of thorny shrubs and bushes.

This is the nature of the only forest in which lions are now found in India. Their movements within this forest are governed by the movements of the animals which they hunt—cattle, antelope and deer.

The Gir is bare and open during the hot weather. Its water supply over miles of arid country is limited to a few deep pools in the dry bed of the Hiran 'river' and in some of the nullahs, in the vicinity of which game and herds of grazing cattle concentrate. But in the rains, when the forest is overrun with rank

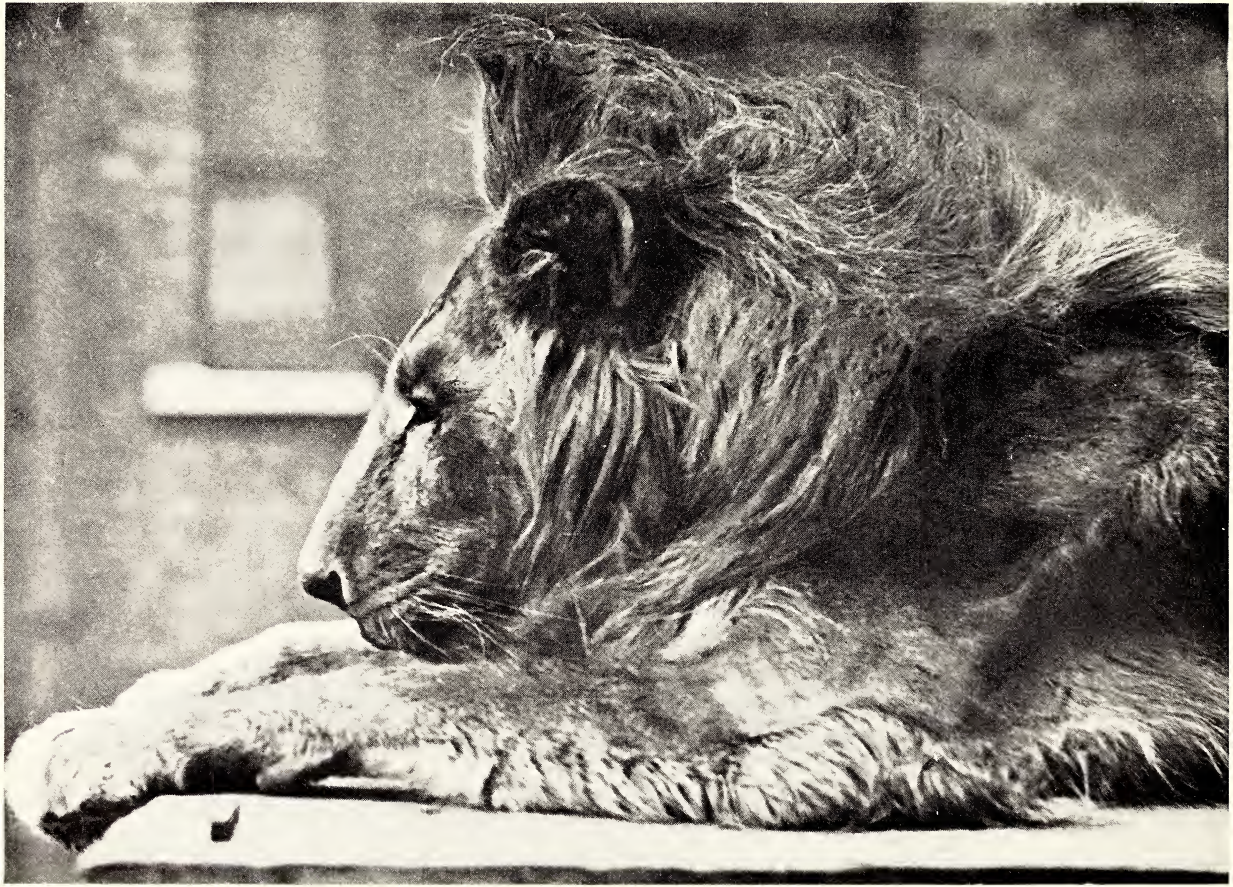


Photo by *F. W. Bond.*

The Asiatic Lion (*Panthera leo persica*, Meyer).

grass and vegetation, abundance of grazing and an abundance of fresh water in its numerous nullahs results in a wider dispersal of animal life. Cattle graze outside forest limits. The lions following their prey, stray into the neighbouring lands.

Indian lions have much the same habits as African. They rest by day under cover. In the Gir they frequently lie up under the shade of some wide spreading banyan tree. At dusk they come out in quest for food. Their roars are heard through the night more noticeably at dusk and again just before daybreak.

Lions are said to rely mainly on scent and hearing when hunting. When hunting alone, a lion will stalk its prey or lie in ambush within 20 or 30 yards of the quarry, waiting to rush upon and seize it as it strays within reach. But when a troop of lions is hunting together, as frequently happens when there are family parties with half-grown young, a combination of effort has been observed among them. Some of the troop, keeping in touch with each other by low grunts, drive the distracted prey in the direction of others who lying silent intercept and slay the quarry. It is said, that in these combined hunts, it is the lion who drives the game and the lioness which kills it; half-grown cubs when present helping. The same combination in hunting has been observed occasionally in family parties of tigers.

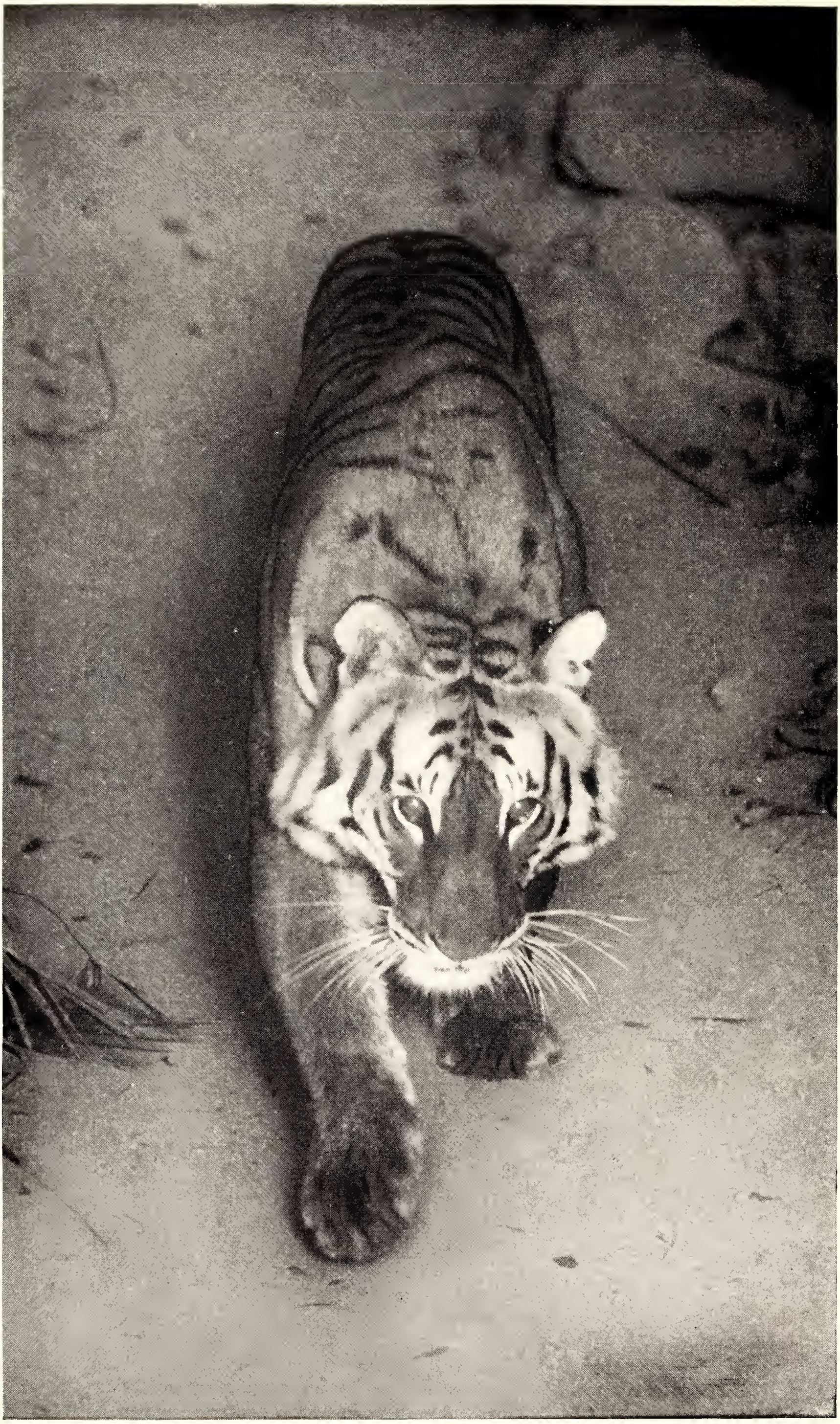
Many observers have written about the social life of lions in Africa. How far these observations apply to the social life of lions in the Gir remains to be discovered. The paucity of numbers, the peculiar conditions under which lions live in the Gir may affect their social behaviour. The underlying cause of animals herding and remaining together is the reproductive instinct: care of the young by the parents prolongs the association. There are some who hold that the lion is a polygamist and that at mating time he acquires a following of females by right of conquest. Single lions with an attendant troop of females are frequently seen but it has also been observed that a lion will leave the troop and go off to live in seclusion with a mate.

There appears to be no particular breeding season. In the Gir the majority of lions appear to mate between October and November and the young are born generally between January and February. Cubs born during the wet season are less liable to survive—conditions in the forest are unfavourable to them and food is scarce. The lioness has her first litter when she is about 2½-3 years old. The period of gestation is 108 days. In the Gir forest the ordinary litter numbers two, frequently three. In the wild state the young are produced at intervals of at least 18 months to two years. The milk canines of a lion cub are not replaced by the permanent teeth till it is about a year old and up to that age the young lion is said to be comparatively helpless in fending for itself. First sharing in their 'kills', with growth the young lions improve their prentice efforts at killing and finally attain mastery in their craft. A number of lionesses with young may associate to form large troops. This herding of females and young is not an unusual feature among social animals. Among lions it probably simplifies the problem of food supply. Equally common is the forming of societies of young males. Young lions when able to fend for themselves may band together. They in turn join up with young lionesses and so form the nucleus of fresh troops. Old lions passed the capacity to hold their own against rivals lead solitary lives.

Within historic times the lion inhabited Northern Greece and Macedonia. Its range extended through Persia and Mesopotamia into the plains of Northern and Central India. Lions may still survive in the wilder parts of Persia and in Mesopotamia; in India they are found only within the province of Kathiawar and there only in the Gir Forest.

Man, the agent who exterminated the lion in Europe and other parts of Asia, was probably mainly responsible for bringing it to the verge of extinction in India. Even in parts of Africa lions are steadily retreating before European settlement. The bolder, more confiding habits of the lion, its herding instincts, the open nature of the country in which it lives provided the opportunity for its destruction in India and elsewhere. Even in the Province of Kathiawar, where tigers do not exist and where no struggle for supremacy between these two giants of the tribe could have taken place, the lion was slowly driven from the Barda and Aleche hills, from parts of Dhrangadra and Jasdan as a result of human settlement and the progress of cultivation.

The number of lions in the Gir is computed to be well below a hundred. It is feared that the small stock will deteriorate through inter-breeding. The laudable efforts of the Junagadh Durbar have so far saved this animal from complete extermination in India, but under existing circumstances it is essential that the neighbouring States should co-operate by refraining where possible from shooting such lions as stray into their borders.



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The Tiger (*Panthera tigris*, Linn.).

THE TIGER (*PANTHERA TIGRIS* LINN.).

Like the human, the animal population of India has its foreign element. Our wild animals include many species which have migrated into India from countries far beyond our frontiers. Prominent among these is the tiger. Though intimately associated with India—the home of the tiger—the country of its origin is believed to be Central and Northern Asia.

Animals which have originated in a particular country have spread over and colonised great portions of the Earth's surface. The country of their origin is traced sometimes by the location of their fossil remains. The earliest known remains of the tiger—indistinguishable from those now living, were discovered in the New Siberian Islands well within the Arctic Circle. Time was, when under a genial climate, Northern and Central Asia supported a rich vegetation and a varied and abundant animal life. Fossil remains of animals discovered in this now bleak and desolate region reveal the past existence of a great variety of animals. Among them were reindeer and red deer, elk, bison and antelopes which, in their day, were preyed upon by tigers, lions and other carnivores.

From Northern Asia, the Tiger extended its territory over the greater part of the Continent, establishing itself wherever conditions were favourable. It did not colonise the high tableland of Tibet, where a combination of desert and arctic conditions prevail, nor did it enter the great Palaearctic Desert which stretches from the confines of Sind and Baluchistan through the greater part of Persia, Mesopotamia and Arabia. The most westerly limits of its migration appears to be the eastern slopes of the Caucasus, the forests of the Elburz Mountains, which lie between the shores of the Caspian and Persia and the northern frontiers of Afghanistan. It is still found in these regions. From the Persian border —its territory must have extended, or may still extend, through Turkestan into Northern Asia. Today, the Tiger survives in Amurland and Korea, in Eastern Siberia and in Mongolia and Manchuria. Southwards, its range extends through China into Burma, Siam and the Malay countries reaching its most southerly limits in the islands of Java, Sumatra and Bali. We are unable to conjecture how long ago the Tiger entered and established itself in India. Its absence from Ceylon suggests its arrival at the most southerly point of its distribution in this country after the land-bridge between India and Ceylon had disappeared. It was prevented from colonising the island by the deep intervening seas. That the Tiger was established in India fifty centuries ago is again suggested by the recent excavations at Mohenjodaro, where the records of a pre-Aryan civilization, whih flourished 5,000 years ago include numerous seals engraved with figures of the tiger.

The Tiger apparently entered India through the hill ranges of Assam. It colonised the thickly forested southern slopes of the Himalayas and subsequently established itself over the greater part of the Peninsula, avoiding its treeless and desert portions.

Variation in Tigers.

It will be seen that the tiger, unlike the lion, is exclusively an Asiatic animal. Throughout Asia there is but one species. Pocock recently summarised the external difference of tigers in different Asiatic countries. He considers that it is possible to distinguish eight races. The Indian Tiger (*Panthera tigris tigris*) is accepted as the typical tiger—a standard for comparison with the tigers of other countries. It is described as a rich coloured, well-striped animal with a short coat. The Caucasian Tiger is distinguished by a tendency to brown both in body colour and stripes. More or less distinct races are said to inhabit Mongolia, Manchuria and Amurland, Northern and Central China, Sumatra, Java and Bali. But series of skins and skulls from all the countries where tigers are found are required for comparison before we can arrive at definite conclusions as regards the extent of variation between the various races. Little is known even about the Indian Tiger. We have still to learn whether the tiger varies in different provinces in India and what differences in its colouration are produced by season or age. Individual variation is great.

Though tigers living in the more humid forests are generally darker and richer in colouring, pale and dark animals may be found in the same forest tract. Again the number of body stripes appears to have little relation to the part of the country in which the animal lives. The number varies in the same district. Some of the characters which distinguish different genera or distantly allied species of animals may have an adaptive significance. But the trivial differences seen in what we describe as sub-species, varieties or geographical races of an animal may have no adaptive importance in its mode of life and little adaptive relationship to the environment in which it lives.

Tigers in Northern Asia assume a heavy winter coat which is shed during the spring. Indian tigers go through a similar though less striking change. They moult their finer winter coats on the approach of the hot weather: the moult is at its height in March.

Size of Tigers.

Opinions differ as to whether the Indian Tiger equals the tigers of Northern Asia in build. Sportsmen in this country have argued about the size of tigers for well over a hundred years. Published records fluctuate between 9 and 14 ft. and some attain even more ambitious lengths. The varied methods used by sportsmen in measuring tigers would give widely different results if applied to the same animal. A stripped skin or a generous tape over curves yield remarkable, if inaccurate results. So might a man add to his height by taking in the contours of his body. A straight line measured between pegs driven at the extremities of the tiger's head and tail should be adopted as the standard to be followed by all sportsmen. It is preferable to register separate measurements of head and body, and the tail. A tiger measuring 10 ft. 7 in. on this basis would be a very large animal. Few Indian tigers exceed 10 ft. in length—the majority fall short of this limit.

The average length of a tiger is 9 ft. to 9 ft. 6 in. The average height 3 ft. to 3 ft. 6 in. The measurements of the skull may provide an index of the size of a tiger. The length is taken in a straight line between the end of the bony ridge which surmounts the braincase—to a point above the incisor teeth. On this basis the tigers of the Nepal Terai show a slight superiority in size over the tigers of Central and Southern India; though tigers as large as any North Indian animal may be found in Kanara or further south. The weight of a tiger averages between 400 and 500 lbs. Individuals far exceeding this weight have been shot. Females are smaller in build. The average length of a tigress is 8 ft. 6 in. The average weight about a 100 lbs. less than the male. Four to five hundred pounds of flesh and bone express the tiger's massive build. Yet, his heavy frame is cast in lines of perfect symmetry and endowed with astonishing suppleness of movement. His massive head, his muscular body, which even in repose reveals the immensity of its latent strength, his rich colouring give the tiger a magnificence which is unequalled by any of the great cats.

Kinship between the Lion and the Tiger.

There is a close kinship between the Lion and the Tiger. There is so much individual variation in both animals that it is difficult to find any constant point of difference in the skeletal structure of the two. What is written in description of one will apply equally to the other. On the average the skull of a tiger is more vaulted and has narrower nasal bones. The facial part of the skull is shorter in relation to the cranial portion. This gives the tiger a greater flatness of face when compared to the lion. The differences between the two are mainly skin deep. Even the tiger-like pattern of many lion cubs indicates the close kinship between the two animals. The mane, so associated with the lion, is not constant in that animal and many tigers wear a ruff of lengthy hairs about the neck and face which is as full as the mane of some lions.

The Tiger in India.

In India the tiger is found under varying conditions of climate and environment. He has left his tracks in the winter snows of the Himalayas at an altitude of 10,000 ft. He lives in humid evergreen forest or in dry open jungle, in grassy swamps or in an amphibious terrain of trees and mud and water.

No statistics are available to give an idea of the number of tigers living in different provinces in India. The opening of the country to settlement, the extermination of game animals, has driven the tiger from districts where he was once common. Where tigers are still found, their numbers probably fluctuate. Though supreme in his forests, the tiger is but one of a community of animals living within a particular area, and is so governed by all those forces which regulate the constantly varying density of its animal population. Changes in the environment in which the animal community lives, the inter-relationships existing between its members are some of the factors which control the number of animals living in a given locality. The hot weather with its scarcity of grazing and water supply may cause a concentration of cattle and game in a favoured locality and with it, a concentration of animals which prey upon them. The monsoon effecting a complete change in plant life, in water supply, in the abundance of parasites, results in a greater dispersal of animals. Factors such as these may reduce or increase the number of tigers living in a given area. Given continuity of favourable conditions a tiger may settle in a favoured locality for an indefinite period and establish his rights within his territory. On his death, his domain is taken over sooner or later by a successor.

Three things are essential to the tiger's territory—the neighbourhood of animals of a size commensurate with his needs, ample shade to sleep in, and water to quench his thirst. An emigrant from cooler northern climes, centuries of acclimatization have left him still intolerant to tropical heat. The tiger needs shelter under cave or covert in the day time from the heat, his pads may blister from long contact with the fiery ground, and many of his kind, particularly during the hot weather take to water and lie in it during the hot hours of the day. In common with many nocturnal animals, should the day be cold or clouded with rain, tigers may be up and about. Always their movements must be regulated by the animals upon which they prey. Like them the tiger is nocturnal. But should game be wanting or the opportunity to take cattle by night—hunger may compel a change of habit and make the tiger hunt by day.

How Tigers Hunt.

Ordinarily the tiger when hungry goes out to seek his food shortly before sunset and ends his hunting at break of day. He will go through cover if need be, but, like most forest animals he prefers the beaten track. He follows the accustomed trail of game, or takes a jungle path, road, a forest fire-line, or an open water course. In the gathering dusk he moves slowly and silently, stopping now and then. His acute hearing makes him conscious of any sound which betrays the presence of his quarry. His eyes attuned to work in the dark—detect the slightest movement, though like all cats, the tiger is less quick in the recognition of objects which are still. Many writers of experience maintain that a tiger hunts with his ears and eyes and makes little use of an enfeebled sense of smell. While the consensus of opinion appears to uphold this view—there are other factors which require consideration. There are those observers who have seen a tiger pick up the fresh ground scent of an animal, and turn in his course to follow it. Another tiger has followed the scent of a wounded quarry and yet another was observed to trace a kill which was dragged from its site. The behaviour of a particular tiger under given circumstances—his failure to discover his food by scent, to wind a man sitting in a tree—provides no evidence that tigers do not use their sense of smell. It is a faculty of no small importance to a beast of prey. To live a tiger has to find, to outwit and to overcome his prey. He must do all this in competition with his own kind and he is compelled to secure his quarry under varying circumstances wherein any one of his faculties may be at disadvantage and wherein success will imply a reliance on others. We know little as to the extent to which nocturnal animals rely on vision in getting their food. We know less about the inner working of the animal mind—we attempt to read it from external behaviour—behaviour which must vary with the individual and with circumstances. It is probable that all the tiger's senses play their purpose in his life—the predominance of any one of his faculties depends upon the individual and equally upon the factors in the environment which are then influencing his action.

In his quest for food the tiger's progress is described as the 'flowing past of a phantom'. His sinuous gliding movement is effected by the simultaneous advance of the limbs on each side of his body. Ordinarily his feet on each side leave a double track, the impression of the hind foot being a little in advance of the fore-foot. The imprint of the fore-foot is larger, rounder and more splayed out than that of the hind. The difference is usually less marked in the spoor of a tigress.

But the type of spoor a tiger leaves varies with the gait of the individual and depends equally upon what the tiger is doing. A slowing down of movement impelled by rousing interest on increased caution may sometimes be read in the reduction of space between the imprints of the fore- and hind-feet. The reduction may end in the feet imprinting a single track, the hind foot being placed over the exact spot vacated by the fore foot. But this is not the impress of care free movement but of highly controlled and deliberate action.

A tiger hunts by stealth. He stalks his animal or lying hidden takes it as it strays within reach. Whether cattle-killer or hunter of wild game, the tiger is accustomed to the habits of his prey and knows how and when and where to find it. His habit is to hunt alone. When in a family party his hunting may be in the nature of a drive; the tiger trying to rush the quarry in the direction of another lying concealed. Such combined hunts are frequent among lions. They have been less frequently observed among tigers.

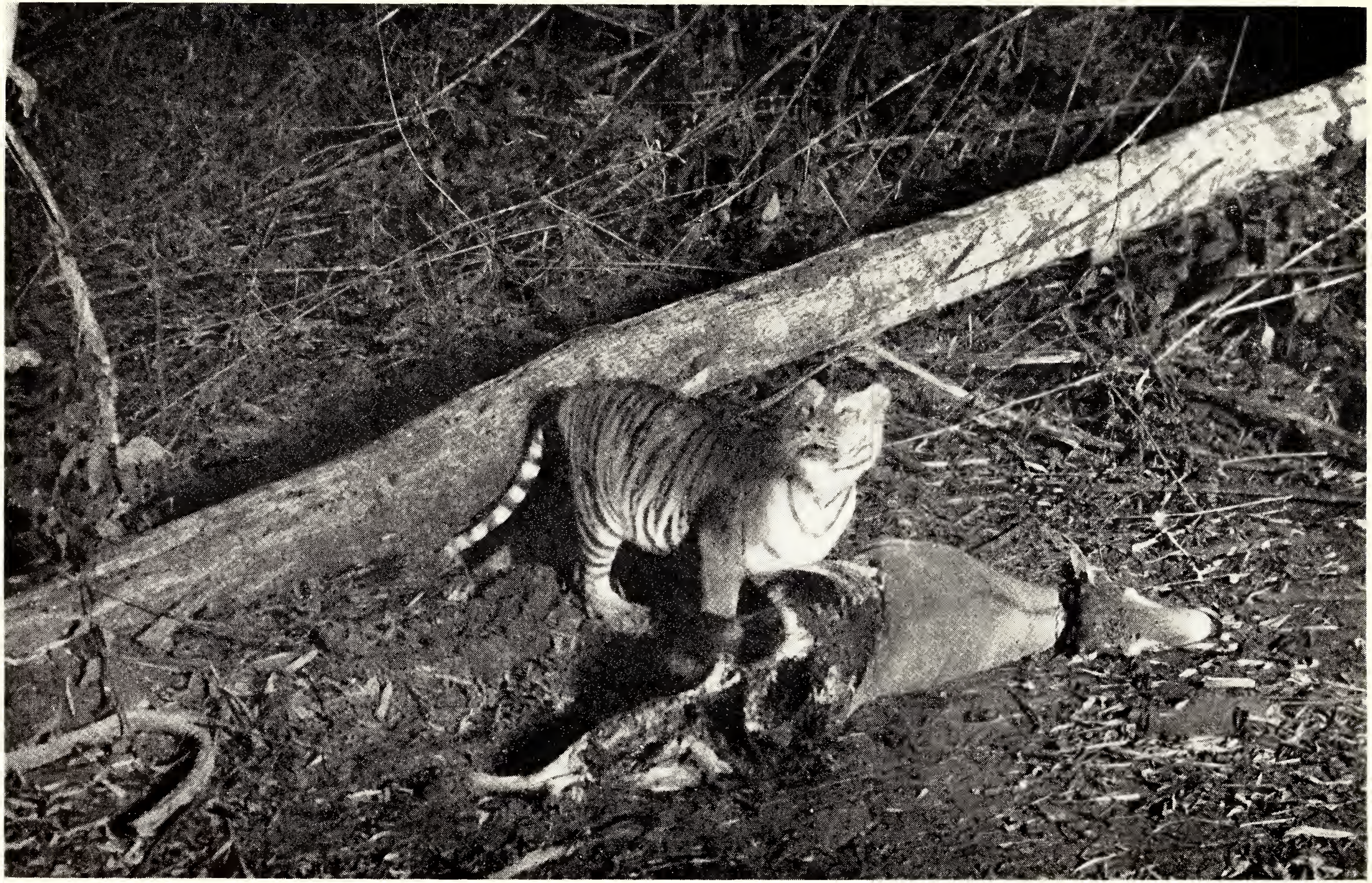
The Killing of the Prey.

A tiger follows no rule in the killing of his prey. He passes from the awkward attempts of the young to the power and mastery of the adult. Equally must he adapt his strategy to the nature of his quarry and the conditions of its taking. There is the haphazard seizure of an animal in flight where desperate claws and teeth strive to retain and hold the moving body, or the timely leap, which takes the quarry in its stride and sends it to the ground—its neck broken by its fall and the opposing wrench of the tiger's hold. Different must be the killing of a standing animal. There are two common ways in which a tiger does this. Coming with slow deliberate approach or bewildering rush he dips under and takes his prey by the throat, draws down and pins its head to the ground and maintaining the pressure of his grasp, strangles his animal. Or, rearing up on his hind legs, he seizes the animal's neck in his jaws and bringing his arms down about its head and shoulders, takes it in violent hold and bears it to the ground. The ferocity of his strangle hold, his ruthless violence in forcing his prey to earth may twist the neck of a heavy animal, or bend it back upon itself till it breaks under the strain and the opposing stress from the body as it falls or is forced to the ground. The neck is not always broken. To break the neck of his prey is not perhaps a tiger's deliberate purpose. Like all the big cats he tries to take his animal by the neck or throat and strangle it. The neck, when broken, breaks from the manner of its seizure, the force exerted and most frequently from the opposing strain of the falling body.

A large animal may be seized by the hind leg. The leg is bitten into above the hock, its tendons severed and the bone broken. With one or both legs broken, bison, tsaine or buffalo despite their bulk and power, fall easy victims. They are killed as they weaken. Tigers in Burma invariably break the legs of a large animal before killing it. The method is less common in India. It is suggested that the more open nature of forests in India gives the clearance a tiger needs for his normal point of attack—the neck or throat. Not much blood is shed in the tiger's process of killing. His jaws maintain their grip, though his animal is dead and its struggles have ceased. The fangs buried in the flesh obstruct the flow and prevent the spilling of much blood. There is no evidence to show that the tiger sucks the blood of his prey.

The Tiger and his Kill.

A tiger brings to his eating the same ferocity and lust which he displays in the killing of his quarry. Savagery when feeding, a common trait in animals, is a demonstration against possible interference. With it, the tiger combines a wild animal's instinctive anticipation of danger. When feeding, or coming to his kill, any sound the reason for which is not apparent may cause the tiger to disappear like a flash. While he desires to hold what he has, his instinct for self-preservation predominates, as it predominates in all animals. Cowardice or bravery, both human characteristics are inappropriate to the description of animal behaviour. Animals do not possess an exalted ethical code. Strong or weak, they normally obey the primary instinct which is to preserve life. Endangering life in defence of themselves is but obedience to the same instinct. Though supreme in his jungles, the one rival a tiger must fear is another tiger who can take his food from him and destroy him in the taking. He fears and avoids Man, but competition from his own kind is the more intimate factor in his struggle for existence. This explains the common impulse of the tiger to drag his kill under cover where he can eat it in greater seclusion—though freedom from interference may induce or circumstances compel him to feed in the open. In eating, his first and most usual choice is the hind quarters. In this he differs



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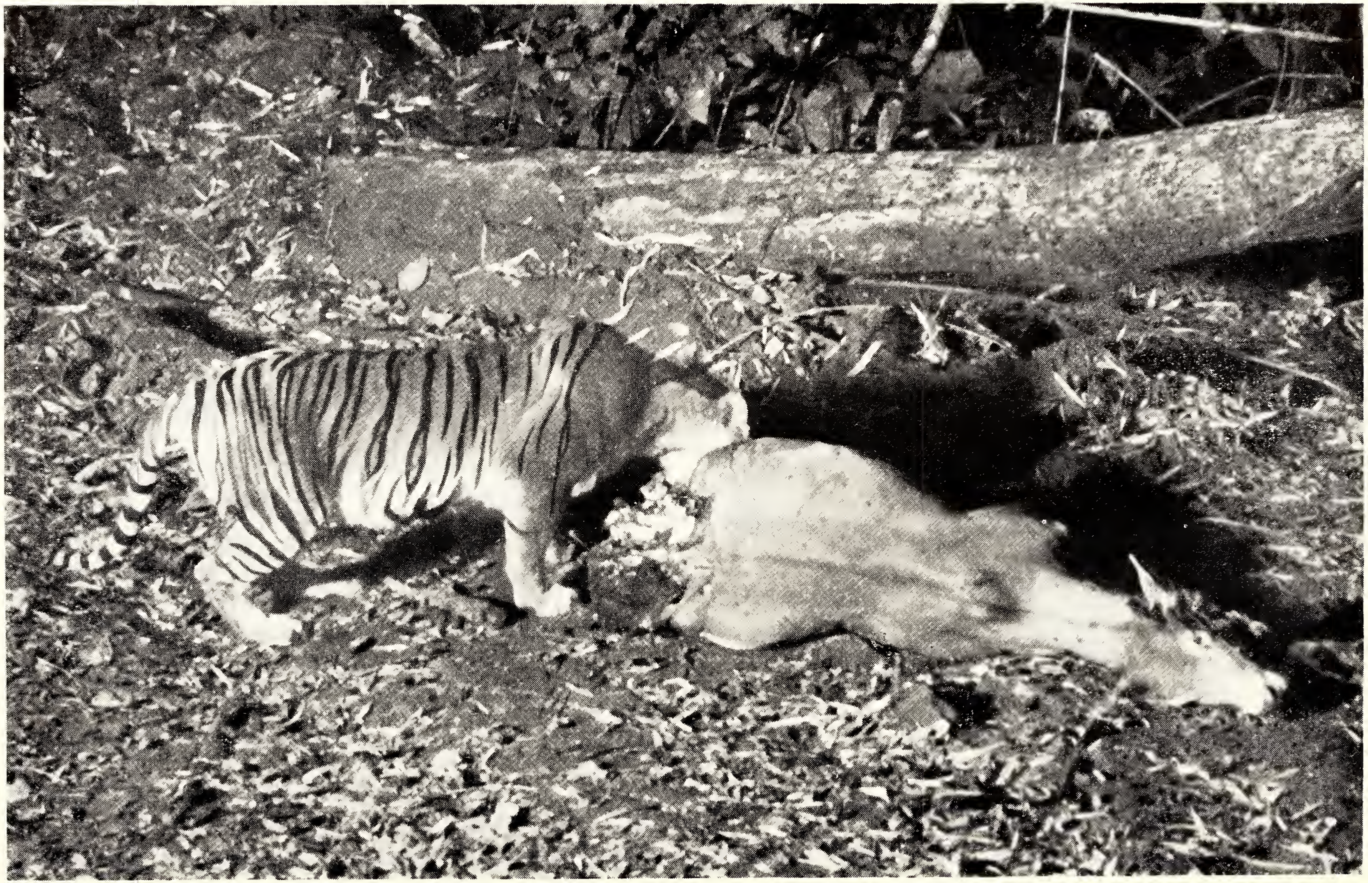
A Tigress at her "kill"

E. H. Peacock.



Copyright. A TIGRESS FEEDING ON HER "KILL". *E. H. Peacock.*

from the Leopard whose custom is to start his meal in the region of the breast bone or stomach. Like the lion, a tiger generally disembowels the body and places the entrails to one side. It may take a tiger the best part of two hours to finish the hind quarters of a bullock and a hungry tiger may eat the greater part of the body at a single meal. The remains of the carcase are left exposed or dragged and hidden under bushes or even concealed with uprooted bunches of grass when no cover is near. The tiger's neglect or care of his preserve of food must depend much upon the density or openness of the country in which he is accustomed to hunt, and the chances or frequency of interference with his kills by vultures and animals which discover and eat it. The abundance or scarcity of food may equally govern his actions.

After satisfying his hunger the tiger goes to drink and then to sleep either in the vicinity of his kill or away from it. Freedom from disturbance, conditions of cover, the need for cool shelter are all factors which influence his behaviour. When darkness sets in or even earlier he returns to his kill and may continue to repeat his visits till the carcase is finished. Or, for various reasons he abandons his quarry.

From hunger or individual preference a tiger may eat a carcase not of his killing however putrid. His usual habit is to feed on his prey when killed. He may even feed on a crippled animal before life is extinct. Ordinarily a period, which may be anything between 4 and 7 days, elapses between successive kills. There is sometimes a simultaneous killing of a number of individuals in a herd of cattle. It is generally the work of a young tiger or of a female with cubs.

Cattle, various species of deer, nilghai, pig and porcupine are the common prey of the tiger. Larger animals like bison, tsaine and wild buffalo, bear and leopard are killed occasionally. Tigers living near villages are said to feed largely on cattle. Whether cattle killing becomes habitual in the individual is not definitely known. It may develop in an individual with age, when the taking of more active and vigilant prey becomes difficult. Unlike the panther, the tiger's association with Man is limited to forest areas, where a variety of food is available and wherein limitation to domestic prey becomes less imperative. It is significant that certain districts in Southern India, where cattle are in abundance, but where deer and other large game are now all but exterminated, are now devoid of tigers, which suggest that the presence or absence of game is a factor in the tiger's selection of a habitat.

The tiger is not usually dangerous to man except when wounded or perhaps under stress of sexual excitement. A tigress with cubs may make a demonstration of frightfulness, charge home or even desert her cubs.

The man-eating tiger is fortunately uncommon. Insufficiency of natural food or causes which prevent the securing of it may convert a tiger into a man-eater. The vice is acquired in age or in youth. The chance killing of a man may initiate the habit in a young animal, or an old or disabled tiger may take to man hunting. Familiarity with the presence of Man subdues his fear, and hunger compels him to attack what his experiment discovers to be the easiest prey. Man-eating appears to be more frequent in females. Difficulty in finding sufficient food for the cubs suggests a reason. Such cubs trained to the vice by their parents may retain the habit through life. In individual instances man hunting like cattle killing, may be a tradition passed on from mother to offspring. This perhaps is the explanation of the repeated occurrence of man-eaters in certain districts of India and their comparative rarity in others where tigers are equally or perhaps more common.

The Calls of Tigers.

In many of his habits the tiger resembles the Lion, but a tiger is more silent. Tigers seldom roar. When they do, their roars can be deceptively like the roar of a lion. Deep and thrilling, the repeated gusts of sound increase in volume and fill the air with their reverberations. This roaring is said to be a mate call. It is sometimes uttered when the tiger rouses at dusk preparatory to going out or while in quest for food. There is the coughing roar which may prelude attack and the 'whoof' which expresses surprise and alarm and a purring note made by blowing air through the lips with which he gives vent to when expressing contentment.

A peculiar call of the tiger, which is much like the belling of a sambhar, has occasioned much comment. The calls of the two animals are so similar that it is difficult to distinguish between them in forests where both tiger and sambhar live. This peculiar call is not the tiger's ruse to decoy a sambhar. It has no concern with his hunting. One suggested explanation is that it is a mate call. The tiger utters it when seeking or keeping in touch with a mate. It is indicated however that the call has been frequently uttered as a direct result of disturbance by human agency and as such is purely an individual expression of surprise, suspicion or alarm.

The Mating and Breeding of Tigers.

The tiger is by nature a solitary and unsociable animal. The bond which brings and keeps tigers together is the reproductive instinct and the subsequent care of the young. This is the general basis of social life in all the lower animals. In India many tigers seem to mate after the rains and the majority of young are born between February and May. We do not know whether the tiger is monogamous. The acquiring of more than one mate will depend, among other factors, on the number of females in condition to breed and the dominance of a particular tiger over other males in the area. Tigers with more than one adult female in train have been seen. Whether the association between a male and female is ever permanent is not known. It appears to end or to be interrupted when the cubs are born. The summary treatment of the cubs by the male may induce the mother's desire for seclusion at this period. It has been observed however that a family party consisting of a tigress and her cubs frequently includes an adult male. The presence of the male may suggest an uninterrupted association of the parents or it may indicate the renewal of sexual activity in the female and the acquiring of a mate. We have no definite knowledge regarding the cycles of sexual periodicity in the larger Felidae. It is suggested that tigers breed after intervals of not less than two or three years, the period during which the cubs live under parental protection. The mother may however be accompanied by cubs of more than one litter—the previous cubs are then fairly well grown and almost in a condition to fend for themselves.

The period of gestation is fifteen weeks. The tigress gives birth to cubs in the jungle, or in a cave or rough shelter of rocks. As many as six cubs may be born in a litter—usually not more than 2 or 3 survive. The cubs are soon able to wander about their lair and when about six months old regularly accompany the mother. The largest family party seen by Mr. Dunbar Brander consisted of an adult male, two full grown females and three cubs nearly as large as the tigress. Such a family party in quest for food may hunt in co-operation—the hunt assuming the nature of the drive. The practice is more common with family parties of lions and provides an opportunity for the training of the young. That the mother tigress trains her cubs to hunt has been observed. Her method is to disable an animal so that it cannot escape the onslaught of her cubs who come in and take a share in the killing. It is probably at this period that the tendencies of the individual to cattle or game killing or even man hunting are formed.

Various observations on the behaviour of individuals have given us our impression of the tiger and the rôle it plays in Nature. With the facts that we gather we attempt to predict what an animal *will do*. This is the aim of our observation. While the individual animal obeys the fixed instincts of its species, its behaviour is influenced by parental tradition—by the experience it acquires through life, by its physical environment, by its changing relationships with the animal community in which it lives. Our knowledge of the true life of the tiger can only come to us by a greater knowledge of the factors which influence its life. We must study not only the animal but also the stage upon which it plays its rôle. We have still to learn more about the tiger's reactions to the varied conditions of its physical environment, to climate, to season, to new situations and to the animal community in which it lives. We have still to learn about its migrations and movements, its sexual relations and its social life. Such knowledge can only come as the result of continued field observation, and more especially from controlled systematic investigation—surely worthwhile in an animal which plays so definite a rôle in the economy of Nature in this country, and which is so surrounded with immemorial romance and interest.

THE PANTHER (*PANTHERA PARDUS* LINN.).

Panther is a word of Greek and Latin derivation meaning 'all animals'. Greek and Roman writers applied it to many predatory creatures, among others the Cheetah, the Weasel and the Lynx. From common usage it is now a recognised name for the Leopard in India.

In its structure a panther exemplifies all those characters which unite and distinguish the Great Cats (*Pantherina*) from the rest of their tribe. It has been shown that in Lions, Tigers, Panthers, Jaguars and in the Ounce, the hyoid bone is loosely attached to the skull as a result of the imperfect ossification of the arms of this apparatus. In all these animals the pupil of the eye does not narrow to a slit, but retains its circular form when contracting. Again in all of them the patch of horn-sheathed spines on the surface of the tongue displays a distinctive position. Now if the skulls of a lion, tiger, panther or jaguar are compared it will be found that they are very similar in form. Except for differences in size and a few slight specific characters there is little to distinguish between the skulls of these animals. Agreement in their skeletal structure suggests their close affinity.

It is true that the Panther and the Jaguar have disinctive colour patterns. But young lions are also spotted or striped and the vestiges of the panther's 'rosettes' are sometimes developed in the markings of a tiger. Colour differences between these animals are less fundamental than they appear.

Panthers and jaguars are lower in stature than tigers or lions. They are less massive in build, longer in body and more lithe in limb. These distinctions are probably associated with their tree-climbing habits. Their roars are remarkably alike but normally quite different from the roaring of lions and tigers. It is believed that the Panther and the Jaguar are descended from a common ancestral stock which originated in Europe or North Asia: that the progenitors of the Jaguar probably migrated into America by way of Northern Asia and established the species in the New World.

Distribution of the Panther.

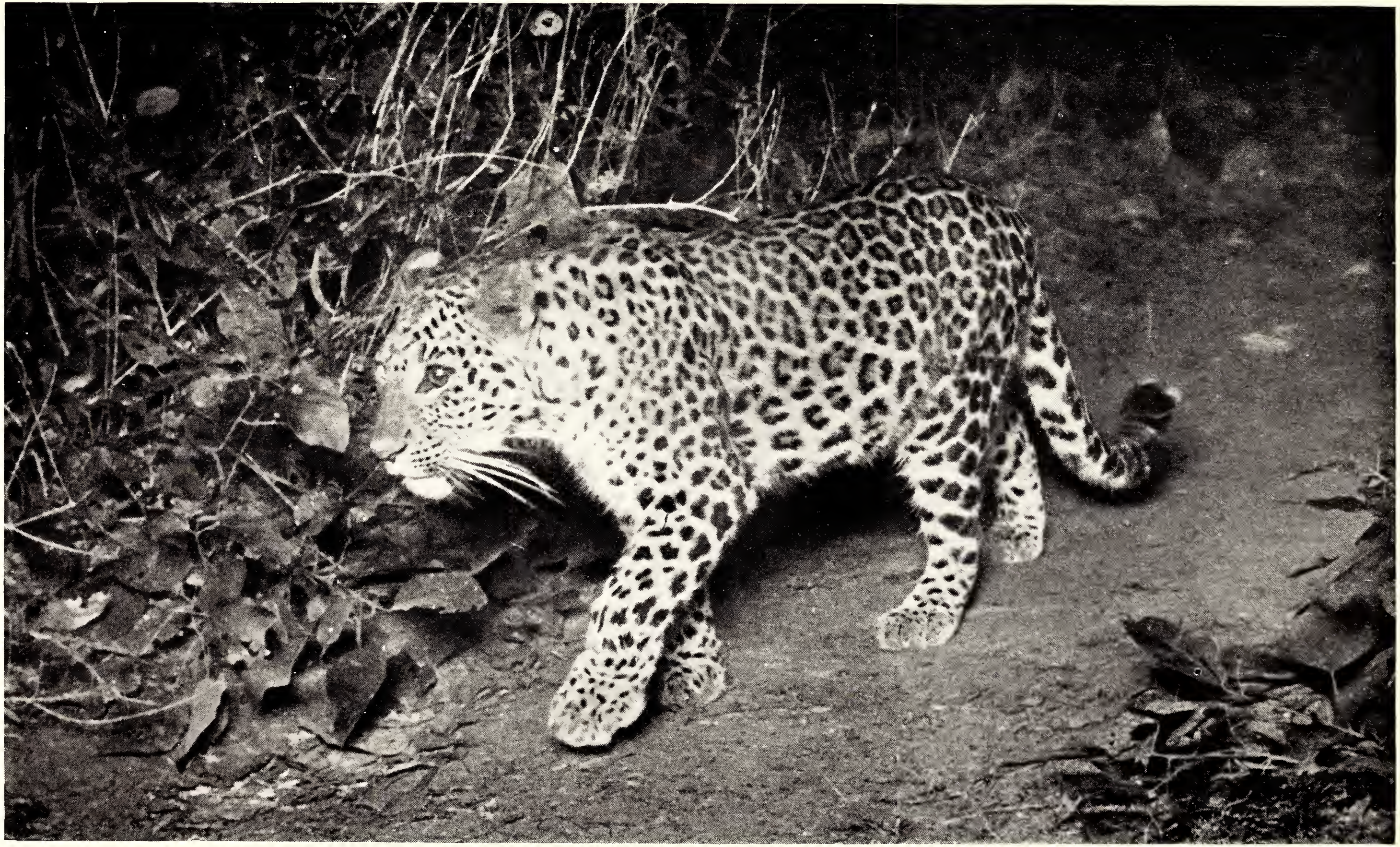
The primeval forests of Europe and North Asia are indicated as the region from which the Lion, the Tiger, the Panther and the Jaguar spread into various countries which they now inhabit.

Fossil remains of panthers, indistinguishable from those now living have been found in the cave deposits of the Pleistocene Age in Spain, France, Germany and England. At the present time the Panther survives in Europe only in the Russian Province of Kuban, north of the Caucasus. But its territory covers practically the whole of Africa and Asia.

In Asia its range extends from Palestine and Syria through Persia to Manchuria and Korea. Southward its territory reaches through China into Burma, the Malay Peninsula and Java and covers practically the whole of India and Ceylon.

Whether the Panther established itself in India before the

PLATE XLIV.



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F. W. Champion.

The Indian Panther (*Panthera pardus fusca*, Meyer).

Lion, we do not know. It may have accompanied or preceded it. Both animals probably entered India from the West. But like the Tiger, the Panther may have also migrated into India through the hill ranges of Assam. That it established itself in Peninsular India before the Tiger is suggested by its occupation of the Island of Ceylon, where tigers are not found. Earlier colonisation of the Peninsula may have enabled the Panther to enter Ceylon over the land-bridge which once connected the Island with the main land. The Tiger's passage, it is presumed, was prevented by the disappearance of this bridge.

Variations in Panthers.

Through the extent of a range covering two Continents there is but one species of panther, living under contrasting conditions of environment, of climate, temperature and rainfall. Such varied conditions of life may have influenced the minor but more or less apparent distinctions seen among panthers in different countries. Variation is especially marked in Asiatic panthers whose colour may range from the sandy grey of the Persian panther to the golden yellow of the Indian and the rusty red of the Javanese animal. Distinctions are also seen in the boldness, the spacing and the size of the rosettes and in the texture, length and density of the coat.

Eleven more or less distinct races or varieties of panther are recognised in Asia. Three are found within the Indian Empire.

The Kashmir Panther (*Panthera pardus millardi*) is distinguished from the Indian by its softer, more furry coat, its grey buff colouring, its small, close-set, thick rimmed rosettes.

The Sind Panther (*Panthera pardus sindica*) is known only from the barren Khirthar hills of the Sind-Baluch border. Its coat is thick, but harsh and rough; its colouring brighter than the sandy grey of a Persian panther but distinctly more pale than the average Indian animal.

The Indian Panther (*Panthera pardus fusca*) ranges from the Himalayas to Cape Comorin and Ceylon. As far as is known, it is indistinguishable from panthers found in Assam and Burma. A typical panther from the Indian Peninsula is a sleek short haired animal with a fulvous or bright fulvous coat, marked with small, close-set rosettes. There is however considerable variation of colour in Indian panthers. At present it is not possible to define the limits of such variation or to correlate it with particular areas. Panthers living in dense evergreen forests are generally richer in colouring than those found in drier open country. In the forests of Burma the ground colour of the Panther is generally a bright chestnut.

Among abnormal phases of colour, black is the commonest. The black of a panther's coat may be as deep as the black of its spots, which are then only discernible in bright light. The black may extend to the tongue and in varying degrees to the gums and palate. The eyes are sometimes a curious blue. A black panther is not a distinct species. Black and normal coloured cubs may be produced by the same parent. The abnormal colour is due to the excessive presence of a pigment called melanin which darkens the hair and other parts of the body. Melanism is common among animals which have a supra abundance of this pigment. The condition is common in panthers, exceptional in tigers. Tigers on the other hand reveal a greater tendency to albinism a condition opposite to melanism in which the dark pigment is entirely or partly wanting. Albino tigers are not uncommon; albino panthers very rare. Melanism like albinism may arise as an individual variation, but when either condition appears in many individuals in a given area, it is probably due to germinal variation, and inter-breeding among such individuals results in the perpetuation of melano or albino forms; particularly if preferential mating takes place. This is instanced perhaps in the successive generations of white tigers in the Rewa State and the comparative abundance of black panthers in certain areas. The causes which give rise to melanism are not known. Black panthers are rarely found in drier and more open country. One is recorded from the Central Provinces and one from Idar State. They are plentiful in Java and in the Southern parts of the Malay Peninsula, and are known from the evergreen forests of Burma, Assam, Nepal and South-Western India. They are quite common in the forests of Malabar. Whether the colour of a black panther is adaptive to the darker conditions of these dense forests, we do not know. Its coat is without obvious pattern. The spotted coat of a panther blends with the checkered light and shade of the jungle by day and converts it into an evanescent phantom in the darkness or in moonlight. Yet both black and spotted panthers thrive in the same forests, suggesting that pattern may be of no essential significance in life of the animal.

There is marked variation in size among Indian Panthers. Some grow to the size of small tigers, others are scarcely larger than some of the lesser cats, though fully adult. It is suggested that differences in size may have some relation to the habits of the animal and that in the Central Provinces and in the drier parts of the Peninsula panthers which live habitually on game within the forests are larger than those which seek their food about towns and villages. Dunbar Brander gives the average dimensions of a forest panther as 7 ft. 5 in. and its weight at about 150 lbs.

On the other hand small panthers are generally common in the hill forests of South India and in the more wooded portions of the Himalayas. The panthers which frequent the cliffs and precipices of the Anamallais and Nelliampathies are distinctively small in build and size. The smallest race is said to be found in the forests of Java.

The average size of a male Indian Panther is 6 ft. 8 in. The tail varies much in length; its length when included with body measurements may give a wrong impression of the size of an otherwise poorly-built animal. Separate measurements of head and body, and of the tail should always be recorded.

Distinctions in size and in the shape of the skull have led to the belief that there are two species of panther in India. Such differences are due mainly to sex. The skull of the adult male panther is larger with larger teeth. Its cranial portion is more elongate, less rounded than in the female and carries a more prominent median crest.

While there is local variation among panthers there is also individual variation affecting both structure and colouring. Individuals sometime exhibit a complete disintegration of markings far exceeding similar deviations in pattern in tigers. So complete may be the fusing and breaking up of the spots, that a particular skin obtained in South Kanara gives the impression of a black panther streaked and spotted with yellow.

The Panther and its Environment.

The Panther, as we have seen, is found over an immense range of territory, covering practically the whole of Asia and Africa. In practice an animal is limited in its distribution, by its habits and its reactions. Its reactions to environment and other influences are so adjusted that it chooses places to live in which are suitable to its needs. A tiger's range is limited by its need for the shade and shelter of forest, for continuous tracts of cover. The lion chooses drier, more open country. Both tigers and lions require the propinquity of large animals for food. A panther is less bound by the physical condition of its environment. It is more tolerant of the sun than the tiger and less dependent on shelter from its heat or on the nearness of a water supply. It thrives in a parched treeless terrain of rock and scrub or in rain swept forests, under extremes of heat and cold, of dryness or humidity.

A panther can subsist on a variety of small creatures which would give no adequate sustenance to a tiger. It can find shelter and security in the scantiest cover. Its adaptiveness to varied conditions of life enable it to overcome those factors which limit the increase and confine the range of lions and tigers.

Diversity in conditions of life produce in the panthers a variation in food and habits.

The Village Panther.

Very considerable must be the influence of Man on the life and habits of the species. The panther's ability to live under conditions where no tiger would survive brings it into freer and more constant touch with Man. As such it is able to profit to a greater extent from such opportunities of food getting as are provided by human agency. As such it has become a greater potential scourge on human life and human property. The panther living near human settlements, particularly outside forest areas preys mainly on domestic animals—on cattle, sheep and goats, on ponies and donkeys and most commonly on dogs. It finds regular opportunity to take grazing cattle, to intercept stragglers from flocks and herds returning home at dusk, to raid cattle pens and enclosures or carry off dogs at night. For the village panther the problem of food getting is simplified. The food is concentrated within a limited area, the occasions for taking it are more or less constant and identical. Further competition for the food is frequently reduced by the elimination of rival beasts of prey for whom the environment is unsuitable, and the prey itself, its alertness enfeebled by domestication, is easily secured. The influence of these conditions on the life of the Panther vary in their effects on the individual. Domestic prey if easily taken must be taken in conflict with Man and such competition usually develops great boldness, cunning and resource in animals. We have come to associate these attributes with the Panther because of their frequent and singular development in panthers living under the educative influence of human association. Nevertheless association with Man seldom changes a panther's instinctive habit of concealment. Secrecy and stealth are the essence of its hunting. Whether it lives in remote forests or in the neighbourhood of towns and villages it maintains its secretive nature, is rarely seen and hunts mainly under cover of darkness.

Faced with the sudden apparition of man in regions rarely entered by him, a panther or a tiger usually reveal no more than the wild beasts' curiosity or suspicion of the unknown. Ordinarily they betray no undue fear, stare a while at the intruder and go quietly away. Experience gained from association with Man may exaggerate this reaction in a panther, may develop in it great fear and suspicion. While familiarity with Man, success in escaping harm, will beget in another outrageous boldness, an indifference to human activity, to lights, sounds or movements, and a disregard for human presence even in broad daylight.

Panthers living near human settlements probably maintain this mode of life through successive generations. For the life of the animal is not only the sum of its fixed instincts—a legacy born of the experience of countless ancestors—but also of parental tradition and of experience acquired in life. Hence many village panthers have come to rely mainly on human agency for their food supply. When the supply is maintained it may lead individuals to establish more or less permanent territory in the neighbourhood of towns and villages, and an interruption or failure in the supply to migration to similar environment where the accustomed food is available. While the type of prey the panther is accustomed to hunt is largely a matter of individual habit and upbringing, these habits are induced in parent and offspring by the conditions of their habitat. Changes in the nature of the habitat must produce a transition in habits of life leading from a more or less complete dependence on domestic animals for food to increasing or complete reliance on wild animals as prey.

The Game-killing Panther.

Conditions of life for panthers which live entirely by the killing of wild creatures must be different. Their prey is more varied in character and habit. It is not concentrated within limited zones. It is less sedentary. Seasonal and other changes in the environment influence its concentration or dispersal in a given area. Such changes in the density of the animal population living within a given area bring about the wider ranging habits of beasts of prey.

Equally, as in the case of village panthers, a continuity of favourable conditions must lead an individual or a pair to establish hunting rights over a territory sufficiently large to supply food requirements.

Apart from these influences there is the factor of increased competition. Forest areas which support a large and varied assemblage of herbivorous animals equally make possible the co-existence of a varied assemblage of predatory species. Now competition between various carnivores is governed by the size of the prey to which each is more or less limited. The herbivorous species form what is called a 'food chain'. Commencing with the smallest forms predators and prey increase in size so that at the end of the chain we have the largest herbivorous animals which are the prey of the largest carnivores. The competition for food between the tiger and panther is thus governed to some extent by the size of the prey to which each is more or less limited. While the tiger and panther are at the same end of the 'food chain' the panther occupies a lower link. The panther must equally face the competition of its own species and in certain areas it is brought into competition with some of the larger cats, like the Clouded Leopard, and the Golden Cat which take a similar prey.

Again, while the strength and prowess of the predator decides the size and nature of its prey, there are some species like wolves and wild dogs which increase their effective size by the strategy of numbers and are able to enter into competition with panthers or tigers.

These are some of the factors which must influence the life and food getting habits of panthers particularly of those individuals whose conditions of life remain unaltered by the artificial influence of human association. The collection of more concise data concerning the panther's reaction to varying environment, to the animal community in which it lives, to competition with Man and other rivals, its migrations, movements, its acquirement of territory would help us to truer understanding of the life and habits of the animal.

The Panther's Method of Hunting.

Mr. Dunbar Brander indicates that panthers in the forests of the Central Provinces which confine themselves to the killing of wild animals display many of the habits and ways of a tiger. In other words they display the truer habits of their species. Their prey consists of various kinds of deer and antelopes, of monkeys, pigs and porcupines. When food is scarce even birds or reptiles are eaten. Like the tiger, the forest panther follows roads or paths or the beaten track of animals through the forest, or waits in hiding for its prey. It seizes its quarry from the ground or leaps upon it from a height such as an overhanging branch. Deer and other animals following their accustomed path are sometimes taken in this way. Monkeys are hunted in the tree tops.

Watching the movements of its quarry from some elevated perch or rise is a common method of hunting. Wild sheep and goats feeding on open hill sides or village cattle in the plain are frequently watched and stalked from such a position. The panther has a keen eyesight and an acute sense of hearing. Its sense of smell is said to be better developed than a tiger's. Opinions differ on this point.

To take its prey by surprise is the basis of the panther's strategy. Its purpose is effected by noiseless approach, an amazing capacity for concealment and a lightning agility in attack. Failure to surprise its quarry and to seize it in the first attempt frequently results in the panther's discomfiture and retreat, even before so humble a quarry as a goat. Tigers reveal a similar trait in their hunting and usually relinquish their prey if they do not succeed in taking it in the initial attack. This is a common trait in the hunting of Cats. A panther's quarry if not small enough to be pounced upon and carried off is seized by the throat and held in a strangle hold. To kill their prey by strangling it is apparently the purpose of the great Cats. The breaking of the victim's neck may or may not follow as result of the seizure. A large and exceptionally powerful panther may break the neck of an animal in the violence and fury of its onslaught. Usually death is caused by strangulation, and may ensue without the infliction of fatal wounds.

As with the tiger, there is no evidence to show that a panther sucks the blood of its prey. Like the tiger it maintains its grip for some time to ensure death. A premature release, as happens when a panther is shot while holding down its prey has resulted in the recovery of the victim.

The Panther and its Kill.

The panther's usual impulse after killing is to drag the carcase under cover to eat it where there is no danger of disturbance. In obedience to this impulse individuals have displayed remarkable ingenuity, eating through the neck or leg of a tethered animal to carry it away. A panther usually commences his meal at the stomach or in the region of the breast bone. The viscera, the flesh of the ribs and the fore quarters are first eaten. The neck and head are left to the last. The unconsumed portion of a panther's kill, if seen early, is remarkably even and clear in outline. The ribs appear as though trimmed with a butcher's knife. A panther may commence his meal on a large animal between the buttocks in the accustomed manner of a tiger. This is said to be the practice of large game-killing panthers. As with the tiger, the unconsumed portion of the carcase is usually dragged and concealed under bushes, put away among the boulders of a nullah or a deliberate attempt is made to cover it with leaves and grass. Though plenty of ground cover is available some individuals prefer to carry and place the kill in a tree. Particular trees may become the regular resorts to which the resident panther of the neighbourhood takes his reserve of food for safe storage. The feat of scrambling up a tree with a full grown cheetal stag in its mouth gives an idea of the strength and resource of an individual panther. Man-eating panthers who have developed this habit may dispose of their kills in the same way.

Dragging the kill away to eat it in hiding, concealing the remains on the ground or in a tree are devices for the protection of the food from rivals. All beasts of prey will feed on any carcase they happen to discover. Besides professional hunters there are professional scavengers like hyaenas and jackals, vultures, crows and even eagles with plebean tastes. Food is the burning question in animal society and the habits of all animals are mainly directed to obtaining a sufficiency of it. Having provided for the security of its reserve of food, the panther usually lies up in its vicinity and returns to its kill when darkness approaches. It may return to its kill at any hour of the day, or it may abandon it altogether. Everything depends on the situation of the kill, if secluded or otherwise upon circumstances, upon the idiosyncrasies, the past experiences of the individual and the state of its appetite.

While some individuals display an almost reckless confidence in approach, a panther returning to its kill is usually the personification of cautiousness. The advance to the kill is slow and the panther's movements in its immediate neighbourhood highly controlled and deliberate. It surveys the surroundings both around the kill and in the trees above it. Anything unusual or abnormal may awaken its suspicion and cause an immediate retreat or abandonment of the meal. Boldness in returning to the kill after being shot at or otherwise disturbed is a matter of past experience, or temperament or hunger. A panther fired at over a kill does not necessarily connect the sound with any particular danger. The sudden report is alarming and puts the beast to flight but if no harm has come to him he usually returns.

The kill, as we have seen, is a source of attraction to a number of rivals dangerous or otherwise and the panther's natural instinct is to apprehend the possibility of interference. The existence of tigers in the same forest is a source of danger of which the panther is acutely conscious. Panthers have been destroyed at their kills by tigers or by more powerful rivals of their own species. They have been killed, routed or otherwise deprived of their rights to a meal by wild dogs and hyaenas. That a hyaena or wild dogs in company may be more than a match for a panther is shown by the number of recorded instances in which victory has gone to these animals. At the same time we read of wild dogs or a hyaena being driven from a kill by the onslaught of a panther. The circumstances of the encounter, the advantage of surprise and other factors, which may or may not be apparent to the observer give victory to one or the other of the contestants and obscure conclusions as to their respective prowess.

Very curious on the other hand is the behaviour of animals—habitual victims of the panther in the presence of their enemy at a kill. We read of cattle and deer continuing to graze unconcerned in close proximity to a panther absorbed in its meal. Their behaviour suggests that these animals appear to divine the presence or absence of hostile intent in a traditional enemy and react accordingly. It has been observed in Africa that zebra and other animals commonly hunted by lions are unaffected by their roars by day and seem to know exactly when these roars threaten danger and when they do not.

The Man-eating Panther.

Speaking generally, like the tiger, the panther does not attack man if unprovoked. If taken unawares a panther may attack in self-defence or turn on his pursuers as when wounded, or harried in a beat. The attack may be made in error, the panther mistaking man for more legitimate prey. This sometimes happens when people are moving or sitting in heavy cover. This chance killing of a man is suggested as one of the causes which lead panthers or tigers to man-eating. The diffidence to attack human beings once overcome may induce an individual to include human beings amongst its prey or may convert it into a habitual man-eater. While the confirmed man-eating panther is fortunately rare the number which occasionally take human food is not inconsiderable.

Failure in the accustomed food supply or in the ability to obtain it contributes to the making of a man-eater. One of the after results of the great famine in Gujerat between 1901-1903 was a marked increase in the number of man-eating tigers and panthers.

The village panther unable to obtain its usual food may take to man-killing. In the recorded case of one individual whose accustomed prey was dogs and cattle, the first victim was a baby, the second an old woman, and the third a boy. Emboldened with its success, such a panther first limiting itself to taking people asleep outside their huts, takes to entering huts, to carrying off people sitting up by a fire and finally to killing in broad daylight. Brought into more intimate touch with Man, the man-eating panther is not only more frequent than the man-eating tiger but more to be dreaded. Familiarity with Man and his ways makes it bolder, more difficult to circumvent and gives it greater capacity for destruction.

The Call of the Panther.

The commonest call of the panther is a succession of deep intakes of air and hoarse barking coughs—an interval of a second separating each respiratory effort. The call is made with the mouth partly open. The air inhaled and expelled through the trumpet-like cavity of the throat beats against the transverse ridges of the palate which, it is suggested, possibly play a part in increasing the sonority of the tone. The call is usually likened to sound produced by the thrust and return of a coarse-toothed saw cutting through thin wood. A pair of panther cubs in captivity gave vent to this distinctive sawing call when moved by the prospect of a meal or when separated from one another. The occasions when they used it may suggest a similar usage in the adults. Among other sounds made by panthers is the low deep threatening growl which is the preliminary intimation of a charge by a wounded or angry beast. The two or three deep coughs which may accompany the charge are very similar to the sounds made by a tiger in like circumstances. A soft purring 'gr-gr', at times hardly perceptible is occasionally emitted in the vicinity of a 'kill' and there is, as in the case of the tiger, the 'whoof' with which a panther expresses alarm and disapproval when surprised and rushing off.

The Mating and Breeding of Panthers.

Panthers like tigers breed all the year round. Mating has been observed in various months of the year. It is a common belief that most animals have well demarcated breeding seasons. Critical investigation has shown that a relatively large number breed throughout the year. This is particularly true in the case of tropical animals. When a species has a demarcated breeding season it recurs rhythmically at the same time every year. The quiescent reproductive organs of the male become active while the female undergoes cycles of reproductive activity. As a general rule, the sexual periodicity of the male is the counterpart of the female's: but with some species the male season may begin earlier than the female or the male may remain reproductively potent throughout the year, while the female experiences cycles of sexual activity and quiescence. The reverse may also occur. We have no definite knowledge as regards sexual periodicity in the larger Felidae. We do not know whether the males are sexually potent throughout the year nor do we know anything about the cycles of sexual activity in the females. In a lioness in captivity periods of heat about a week in duration occurred at intervals of three weeks till the animal became pregnant. Whether similar condition obtain among the larger felines in the wild state remains to be discovered. Such information is extremely difficult to obtain particularly in relation to animals in the wild state. When animals are shot, microscopic examination in the field of the fresh contents of the reproductive organs in both may shed some light on the points raised. It cannot be doubted that a mass of interesting details remains to be discovered which would give us a clearer understanding of the breeding habits and social life of these animals.

The intervals at which panthers produce a litter in the wild state are not definitely known. A pair of panthers in captivity had three litters in 3½ years. That sexual activity in the female recurs shortly after the production of a litter is instanced in the case of a female accompanied by two cubs computed to be above two, but not more than 6 months old. The parent which was shot during the month of May was found to contain four foetuses. If the age of the cubs was correctly estimated and if we set their age at the estimated maximum of 6 months, then her cubs were born approximately in December. The period of gestation being 3 months, a second litter would have been produced approximately at the end of July. This gives an interval of nine months between the production of two litters. The case may or may not be exceptional but it points to a potentially high rate of breeding among panthers which is probably one of the reasons why the species maintains its numbers in spite of all the efforts to reduce them.

Having acquired a mate there is little reticence in the courting of the panther. The procreative instinct overcomes all accustomed considerations for silence and secrecy. Their mating is accompanied by noisy demonstrations, by snarling and spasmodic roarings and by intervals of play, of gamboling and chasing dictated by the receptive or resentive attitude of the female. Mating may continue even after pregnancy is well established. There is a record of a pair seen cohabiting, the female when shot, was found to be bearing three foetuses about two weeks old. It is believed that the association of the male and female continues when the cubs are born. Whether it is ever permanent is not known. In the tiger it is believed that the association is interrupted at this stage. We have seen that among panthers sexual activity may recur shortly after a litter is produced. In these circumstances the male may be the original partner or a new-found mate. Mr. R. C. Morris has seen a family of 6 panthers consisting of an adult male and female, 2 three-quarter grown cubs and 2 cubs (about 2 months old). The adult male was possibly not the father of the larger cubs. That a female losing her mate will in favourable circumstances promptly take another is seen in the case of a panther acquiring a fresh partner twenty-four hours after the death of her previous mate.

The period of gestation is said to be about 12 weeks. Two to four cubs are usually produced. The mother chooses a cave, the hollow trunk of a tree, an overhanging rock or even a porcupine's earth as a shelter for her litter. She is assiduous in her care of them and is said to display greater determination in their defence than is usually seen in the tiger. Nothing precise is known about the period of lactation or when the cubs are weaned or how long they continue to live with their parents or when they attain maturity. Females accompanied by cubs almost as large as the parent have been frequently observed. From an early age the cubs display their predatory instincts, going through the process of crouching, stalking and springing at one another in the manner of the adult. As with the lions and tigers the mother is said to watch the early attempts of the young in making a kill. Col. Mosse records his observation of the behaviour of a female with a cub about as large as herself at a kill. The cub was all concentration while the mother affected complete indifference to the tethered bait and changed her position only to get a better view of the efforts of the cub. The conflict between the impatience of youth and the instinct for cautious approach was strikingly apparent in the efforts of the cub to stalk its quarry. The interesting *denouement* was unfortunately prevented by a shot from the observer.

The high rate of breeding among panthers has already been indicated. Apart from this, the panther's wide range of food and its powers of resistance to adverse influences of environment have endowed it with those attributes which make for survival and which enable it to maintain its being over the vast range of territory which it inhabits. Man's efforts at extermination have made but little impression on its numbers in this country. Though it has not the magnificence of the tiger nor the imposing presence of the lion, the panther typifies in itself all the distinctive attributes of the Great Cats. It exhibits in perfection that symmetry of form, that combination of grace, strength and agility which distinguish its tribe. The panther is the embodiment of the ideal of a beast of prey.

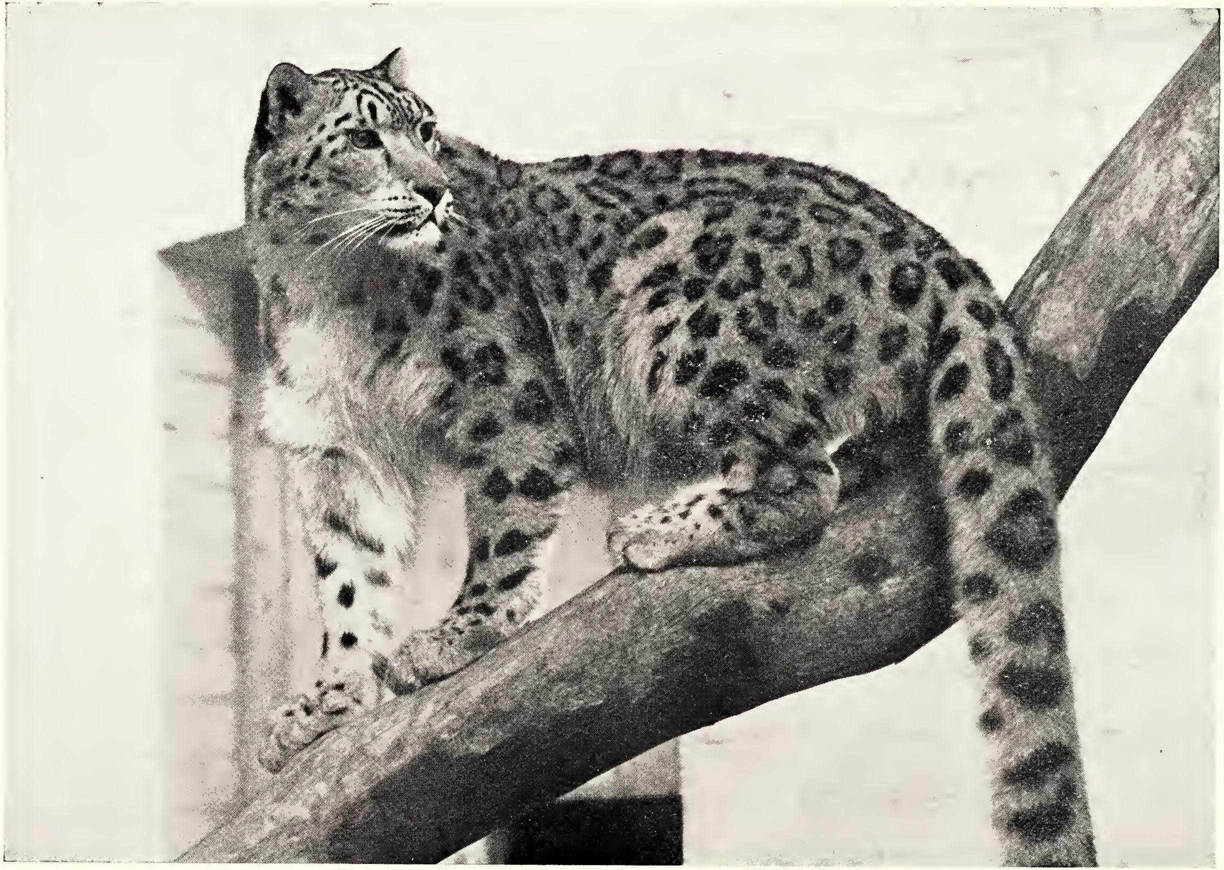


Photo by F. W. Bond.

The Snow Leopard (*Uncia uncia*, Schreber).

THE SNOW LEOPARD OR OUNCE
(*UNCIA UNCIA* SCHREBER).

The Snow Leopard is perhaps the most beautiful of all the cats. The soft colouring and luxuriant beauty of its fur, particularly in winter, is unrivalled. In common with all creatures to whom Nature has given a special endowment of beauty it pays the price in being persistently sought after and killed by Man.

The known range of the Snow Leopard is the high tablelands of Central Asia reaching northwards into the Altai Mountains and southwards to the Hindu Kush Mountains and the Great Himalayan Range.

An affinity between the Snow Leopard, the Lion, Tiger, Panther and Jaguar is deduced from a similarity in the structure of the hyoid apparatus in these animals. The Snow Leopard is placed in a separate genus because of peculiarities in the structure of its skull. Among the more obvious differences are the shortness of its muzzle, the elevation of the forehead and the vertical chin. A more fundamental distinction is seen in the structure of the auditory bullae—the bony swellings on the under surface of the skull, close to the ear openings. The auditory bulla of an Ounce is divided internally by a vertical partition into two nearly equal chambers. In the tiger, lion, panther and jaguar the chambers are unequal.

The ground colour of the Snow Leopard's coat is soft grey, paling to pure white on the underside. The spots are unbroken and distinct on the head, nape and lower parts of the limbs. On the body they break up into larger, paler rosettes. The rosettes are less distinctive in the more luxuriant fur of the winter coat; a black streak extends from the middle of the back to the root of the tail. Except for a few dark blotches the fur of the belly is pure white.

Little is known about the habits of the Snow Leopard. It is entirely nocturnal. During summer the animal lives in the higher altitudes of its range. It has been seen at a height of 18,000 ft. upwards. In this treeless region it preys on burhel, ibex and on marmots and other rodents, occasionally taking a calf or a sheep from the flocks grazing in the higher reaches during Summer. In Winter, Snow Leopards come down to the warmer valleys as low as 6,000 to 7,000 ft. where they find more frequent occasion to take domestic prey and offer better opportunity to be trapped or shot. Nothing is known about their breeding habits.

SUB-FAMILY II: *ACINONYCHINAE*.

THE CHEETAH OR HUNTING-LEOPARD
(*ACINONYX JUBATUS* ERXLEBEN).

In India the Cheetah is all but extinct in the wild state. It once ranged from the confines of Bengal through the plains of the United Provinces, the Punjab and Rajputana, through Central India and the Deccan. It is not known to have occurred in South India and Ceylon. Evidence of its existence in recent years in some parts of its known range is seen in such records as the Society has been able to collect. A Cheetah was killed in 1918 and another in 1919 in the Mirzapur District of the United Provinces. Five Cheetahs are recorded as having been obtained in this Province during the previous twenty-five years. In the Central Provinces, the Cheetah appears to have been not uncommon at one time in the Berars. Three were shot in the Melghat Forest area in 1890 and one in 1894 and one at Wano in 1895. Rumours of their existence in parts of Berar, the Seoni Plateau and Saugor still persist. They were apparently once common around Hyderabad, Deccan. The only part of the Bombay Presidency where Cheetahs were known to occur recently is the tract of rugged country known as the Tanga in the centre of the province of Kathiawar. In 1884 it was estimated that there were not more than twenty of these animals in this area. A female and four cubs were shot at Rajkot in 1894.

Outside India, the range of the Cheetah is said to extend northwards to Russian Turkestan and Trans-Caspia. In South-Western Asia its range is believed to reach from the frontiers of Sind through parts of Afghanistan, Baluchistan and Persia and Mesopotamia to Syria and Palestine and thence into Africa, where cheetahs are, or were once found as far south as the Cape. To what extent it survives in these Asiatic countries is not known. There is a record of a female and cubs taken at Nasriyah in Mesopotamia in 1928, but the animal was not known to the local Arabs.

Certain peculiarities in the structure of a Cheetah differentiate it from all other cats. In size and form a Cheetah looks like a long-legged slender-bodied leopard. But its slimness of body and length of limb are equalled by some cats such as the African Serval. Its head is rounded and relatively smaller than in any other form of cat—the facial region and particularly the cranium slopes steeply downwards and gives its skull a dome-like shape.

The Cheetah's most distinctive character is the structure of its feet. Its claws are usually described as non-retractile. The claws of cats are retracted and raised from the ground by elastic ligaments which pull on the terminal joints of the toes. Now the claws of a cheetah are approximately if not quite as retractile as in some species of cats. Their distinctiveness lies in this that the claws of cats are covered in varying degrees by sheaths of skin, while the claws of a cheetah are always bared owing to the entire absence of skin sheaths.

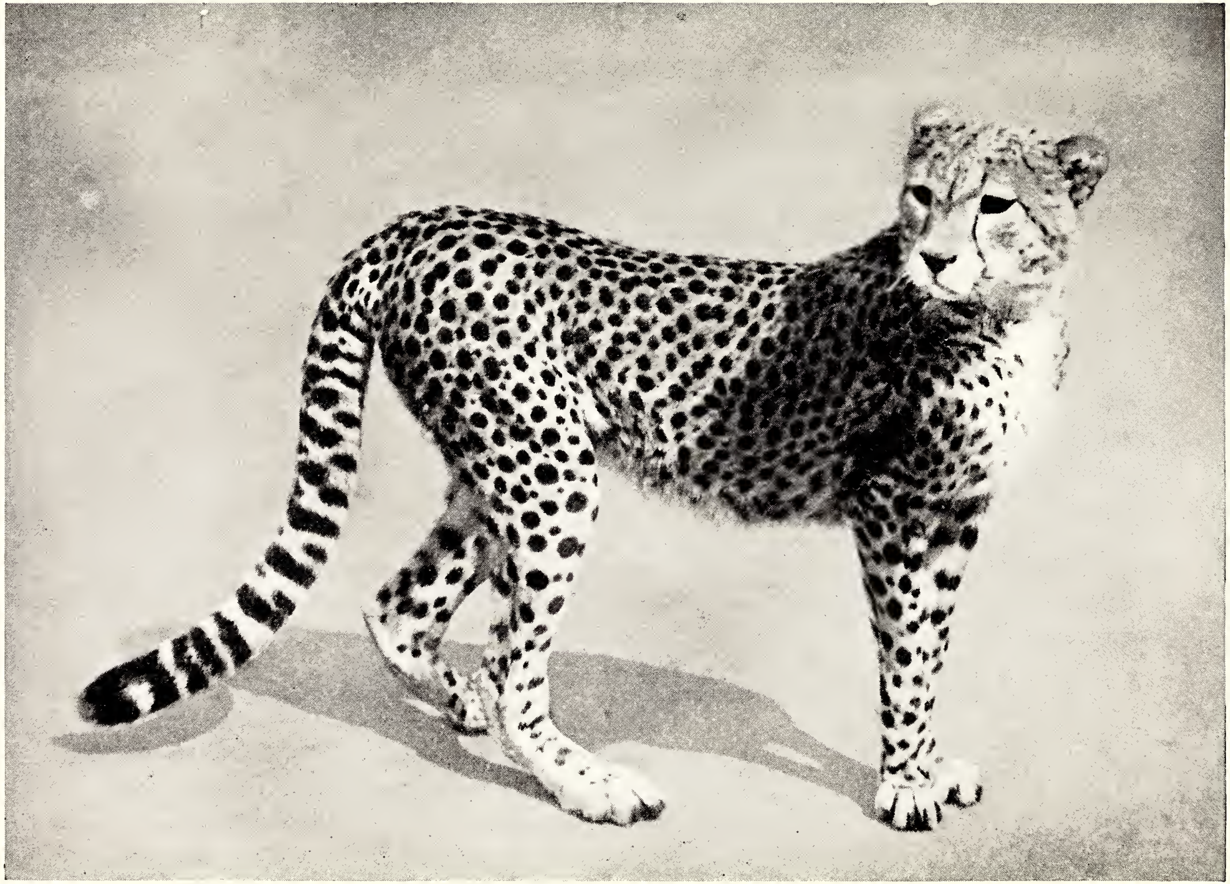


Photo by F. W. Bond.

The Cheetah or Hunting Leopard (*Acinonyx jubatus*, Erxleben).

The colour of an adult cheetah varies from tawny to a bright rufous fawn. Its coat is pale below and spotted almost everywhere with small round solid black spots. The chin and throat are buffy white, a black line runs from the corner of each eye to the upper lip, and there is a less distinct line or row of spots from the corner of the eye to below the ear. The fur is coarse; the lengthening of the hair on the neck suggests an incipient mane. A pair of cubs taken in the Berars are described as having long grey silky hair, without spots, covering the head and back and reaching half way down the flanks, giving the cub an appearance of wearing a great coat. The remainder of the body was covered with short grey hair sprinkled with single black spots. A cub taken in Nasiryah in Mesopotamia is described as being fawn-coloured—the hair on the upper part of the body was 2-3 in. long and unspotted, while the limbs and lower part of the body showed a sprinkling of dark spots. The head and body of a cheetah measures about 4-5 ft., the tail 2-5 ft., its height is from 2 ft. to 2 ft. 9 in.

We know little about the habits of the Cheetah in the wild state. In India it is usually found in low rugged hill country bordering the plains; near Hyderabad it is stated to live in holes in rocks or among accumulations of rocks and boulders. It preys on antelope, gazelle and nilgai and such creatures as it can master. One was shot in the U.P. while stalking a sambhar. Unlike other cats, speed and not stealth of movement is the essence of the Cheetah's hunting. All those characters which distinguish the Cheetah from other cats have arisen from its distinctive method of pursuing its prey. The small head, narrow chest and body, long sinewy limbs, and powerful hind quarters are designed for speed; while its protruding claws, hard, pointed pads and larger hind feet are well-fitted for securing a firm hold on hard or sandy ground. Crouching low, a cheetah takes advantage of every inch of cover or unequality in the ground till it gets within a distance to make its rush upon its quarry. While it lacks the elasticity of gait and the suppleness of body so distinctive in the cats, not the fastest antelope can equal a cheetah's initial speed. Coming up with its fleeing quarry, the Cheetah fells it by striking its hind legs from under it. The animal falls and is then seized by the throat. This manoeuvre of tripping up its prey was constantly observed in the play of a pair of cheetah cubs. The pursuer going at full speed always attempted to upset its mate by striking at the hind legs and having felled it, made for and worried it at the throat. Failing to seize its prey in its initial rush the Cheetah appears to have no reserve of strength or breath and usually gives up the chase.

Nothing is known of the breeding habits of the Cheetah in India. There is a record of female with 4 cubs which was shot near Rajkot in Central India. The mother and one cub were away when the other cubs were discovered under a bush. A pair of cubs a week old were taken in the Berars in December.

The Cheetah has been for centuries the playing thing of princes, Asiatic, African and European. When taken young it is easily tamed and trained to show its wonderful speed. A couple of cheetahs were sent as a present to Anastasius, Emperor of the East, at Constantinople in A.D. 439 from whence the sport reached Italy and obtained an enormous vogue among the wealthy, extravagant grandees of the great City States. The Turks, Moors and Persians alike used cheetahs in hunting. In India the Cheetah is usually taken blind-folded in a cart to the scene of the hunt. In the proximity of a herd of antelope it is unhooded and slipped from its leash: a short crouching stalk and a few bounds of great length and rapidity and the hunt is over—the quarry has escaped or the Cheetah holds it in a strangle-hold by the throat, till the keeper comes up and having cut the captive's throat rewards the captor with a drink of warm blood collected in its accustomed feeding bowl.

Sub-family III: *FELINAE*: TYPICAL CATS.

We have dealt with two groups of the Cat tribe, one, the *Acinonychinae*, included the Hunting Leopards, differentiated from all other cats by the absence of protective sheaths to their claws, and the other, the *Pantherinae*, comprising the Lion, Tiger, Jaguar, Leopard and Ounce, distinguished in their anatomy by the peculiar attachment of the hyoid apparatus to the cranium. It has been explained that in these Great Cats the supporting arms of the apparatus is composed partly of elastic ligament which gives greater mobility to the larynx and has its influence on the voice of these animals. The typical cats including all the smaller and medium sized forms are grouped in a third division of the tribe: the *Felinae*. In all these species the hyoid apparatus is normal. Its arms are formed of an uninterrupted chain of small bones which hold the larynx close up to the skull and restrict its movements. From this distinction in the structure of the hyoid apparatus arises those differences in the character and sonority of the voice between the great and in the lesser cats. The smaller species do not roar in the manner of lions, tigers or leopards. Apart from the roar, there is another distinctive feature about the voice of those cats in which the hyoid apparatus is normal. This is the familiar 'purr'. The great cats never purr—on the other hand, widely different species like cheetahs, pumas, lynxes and the various forms of smaller cats express pleasure and contentment by that sound.

No. 7. THE JUNGLE CAT (*FELIS CHAUS* GULD.).

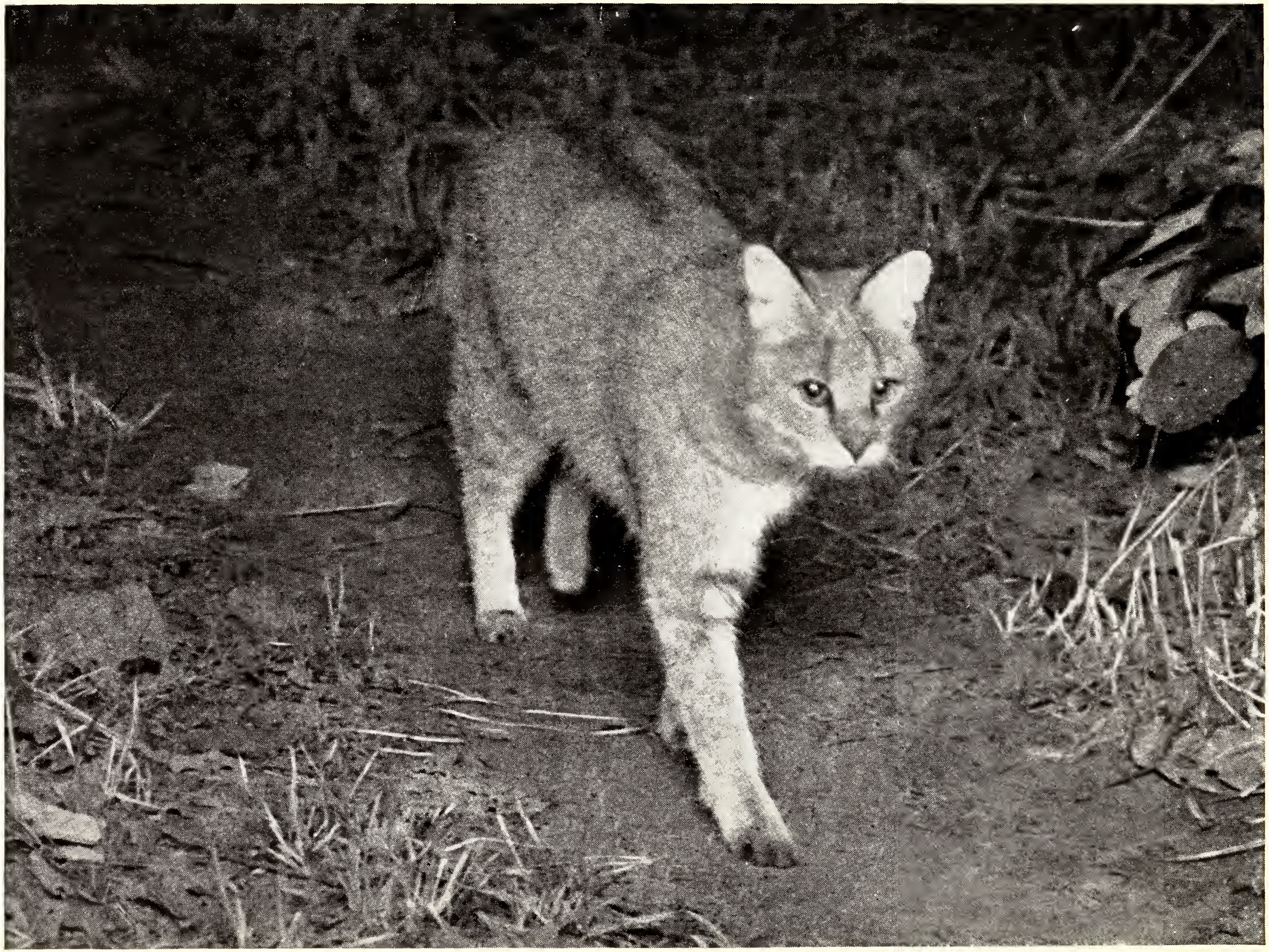
The Jungle Cat has a wide distribution ranging from North Africa through Western Asia into India and Ceylon, Burma and China. The typical form of this cat, *Felis chaus chaus*, is found in the Caspian area from whence the species was originally recorded and described. Over its extensive range, 3 or 4 races of the Chaus are distinguished. The race found in India, Burma and Ceylon is known as *Felis chaus affinis*. It is said to differ from the Jungle Cats of Egypt, Palestine and the Caspian by its relatively longer tail, bright foxy red ears and slighter build. Its skull is narrower and the teeth less strongly developed. Some of the Jungle Cats from the reed beds of the River Tigris in Mesopotamia were indistinguishable from the Indian race, others approached the African form.

The Jungle Cat, the common wild cat of India, is found practically all over the Peninsula from the Himalayas to Cape Comorin. It is commoner in the drier parts of the country keeping more to grass-land and scrub-jungle and the reedy banks of rivers. In Ceylon and Burma it is again more common in the drier zones.

With its long legs and comparatively short tail—the Jungle Cat has a very distinctive appearance. Its pale green eyes give it a coldly cruel expression. The colour of its fur varies from sandy grey to yellowish grey. The tail is ringed with black towards the end and has a black tip. The paws are pale yellowish; black or sooty brown underneath. The ears are reddish, ending in a small pencil of black hairs. The underside of the body is paler with vestiges of stripes on the underside and flanks. Head and body about 2 ft. in length; tail 9 in. Weight anything from 8 to 25 lbs.

The Jungle Cat is frequently about by day—more usually in the mornings and evenings. Its movements in the open are much like those of a small panther. It preys on small mammals, birds and, when near villages, on poultry, making bold to seize its prey even in the presence of the owners. Very swift and exceedingly strong for its size, it is quite capable of bringing down larger game. Crump, writing of these cats in Kumaon says that it was not at all uncommon to find the quills of porcupines which they had killed or attempted to kill embedded in their paws.

Little definite is known about its breeding habits. Blanford states that it has two litters in a year. The kittens are easily tamed and purr like a domestic cat when pleased. They resent the approach of strangers and remain amusingly savage at feeding time.



Copyright. F. W. Champion.

The Indian Jungle Cat (*Felis chaus affinis*, Güld).

THE DESERT CAT (*FELIS ORNATA* GRAY).

The Desert Cat is found in the desert wastes and sand hills of Sind, Cutch, Rajputana, from whence its range extends to the more arid portions of the Punjab, Kathiawar and the eastern parts of the Central Provinces.

From the structure of its skull and teeth as well as from other characters, it is deduced that our Desert Cat is the Indian representative of a group of cats, typified in Africa by the African Wild Cat, *Felis ocreata*, and in Europe by the European Wild Cat, *Felis sylvestris*. Incidentally it is interesting to mention the theory proposed by Pocock that the domestic cats found about houses and villages in India—of which there are two types, one spotted or streaked, the other uniformly grey or yellowish grey have been derived from the African Wild Cat, *Felis ocreata*, either by the introduction of tamed animals or by the reclaiming from the wild state of examples of this species which may have inhabited India in comparatively recent times. Mr. Pocock can find no evidence to support the older theory that our domestic cats have originated from indigenous Indian species such as the Chaus (*Felis chaus*) the common Jungle Cat of India, the Leopard Cat, or the Rusty Spotted Cat. It would be interesting to have authentic evidence of the inter-breeding of wild and domestic cats in India. On the other hand various so-called species of wild cats from India such as the Waved Cat (*Felis torquata*) from Nepal and Kashmir, *Felis inconspicua* from Rajputana, and *Felis huttoni* from Afghanistan are believed by Pocock to have arisen as a result of the description by different naturalists of the various colour forms of the European Wild Cat, *Felis sylvestris*, which is found in a feral state in many tropical countries.

Not much larger than a domestic cat, the Indian Desert Cat has pale yellowish fur more or less infused with grey and marked with numerous black spots. The terminal half of its tail is ringed with black. It has two horizontal stripes on its cheeks, numerous dark cross lines on the outside of the limbs and the usual two distinct black bars on the inner side of each fore-arm. The chin, throat and breast are white and unspotted. The ears are coloured like the back, with a few black hairs at the tips. It inhabits sandy plain and hills, where it preys on birds and rodents. One was killed while feeding on the carcase of a sheep. Nothing is known of its breeding habits.

THE LYNX (*LYNX LYNX* LIN.) AND THE CARACAL (*LYNX CARACAL* GULD.).

The genus Lynx includes three distinct groups of animals—the typical Lynx (*Lynx*) and its various species and races inhabiting the boreal region of North America and the cold and temperate regions of Europe and Asia, as far south as the Mediterranean and the Western Himalayas. Secondly, there are the Lynxes of the temperate region of America which range as far south as Mexico and lastly, the Caracals (*Lynx caracal*) which inhabit South-Western Asia and the greater part of Africa.

The true Lynx which occurs within our limits in the upper Indus Valley, in Gilgit, Ladak and Tibet is probably a race of the ordinary lynx of Northern Europe and Asia—distinctive in its pale sandy grey or isabelline colouring—hence its name *Lynx lynx isabellina*. It is strongly built cat of medium size with a short tail, broad head, large triangular tufted ears. Its paws are large, the claws well-sheathed, and the pads more or less concealed by hair. Its face is framed with a partial pendant ruff of long hair. In summer, its coat shows a sprinkling of spots which may persist, but usually disappear in the heavier winter coat, except on the limbs and flanks. The Lynx is a creature of high altitudes where it preys upon birds and such animals as it can kill from rodents to sheep and goats. Writers have commented upon its wild and fierce disposition. Its keen eye-sight and hearing are proverbial. Rarely seen—little is known of its habits. It is said to have 2 or 3 young—the mother usually hiding her litter in a cave or in a hole among rocks.

The Caracal (*Lynx caracal*) known as the *Siyah gosh* or 'black-eared one', is found in Sind and Cutch and is said to be common in the North and North-West Hills of the Cutch State. It is found in the drier parts of the Punjab, Rajputana, the United Provinces and Central India. Outside our limits its range extends into Persia, Mesopotamia and Arabia and over the greater part of Africa.

The Caracal has the broad head and tufted ears of a true lynx. Like the Lynx it stands higher in the hind limbs than on the fore, but it is smaller and lighter in build and has a longer tail. Its skull bears a general resemblance to that of a lynx, but is narrower in the cranial and facial portions and recalls in some of its structural characters the skull of a typical cat (*Felis*). Its coat though not as dense as that of the Lynx is yet thick and soft. The colouring is a uniform reddish grey above fading into buff or white below. Faint indications of spots are present on the under surface and sometimes on the back.

An uncommon and elusive animal, little is known about the caracal in the wild state. It is a creature of desert and scrub jungle, where it preys on birds, which it is said to take in flight by springing up at them, on rodents, antelope and small deer. There is a record of a caracal attacking a man in the Mirzapur District, U.P., but it is believed that the animal was driven to the

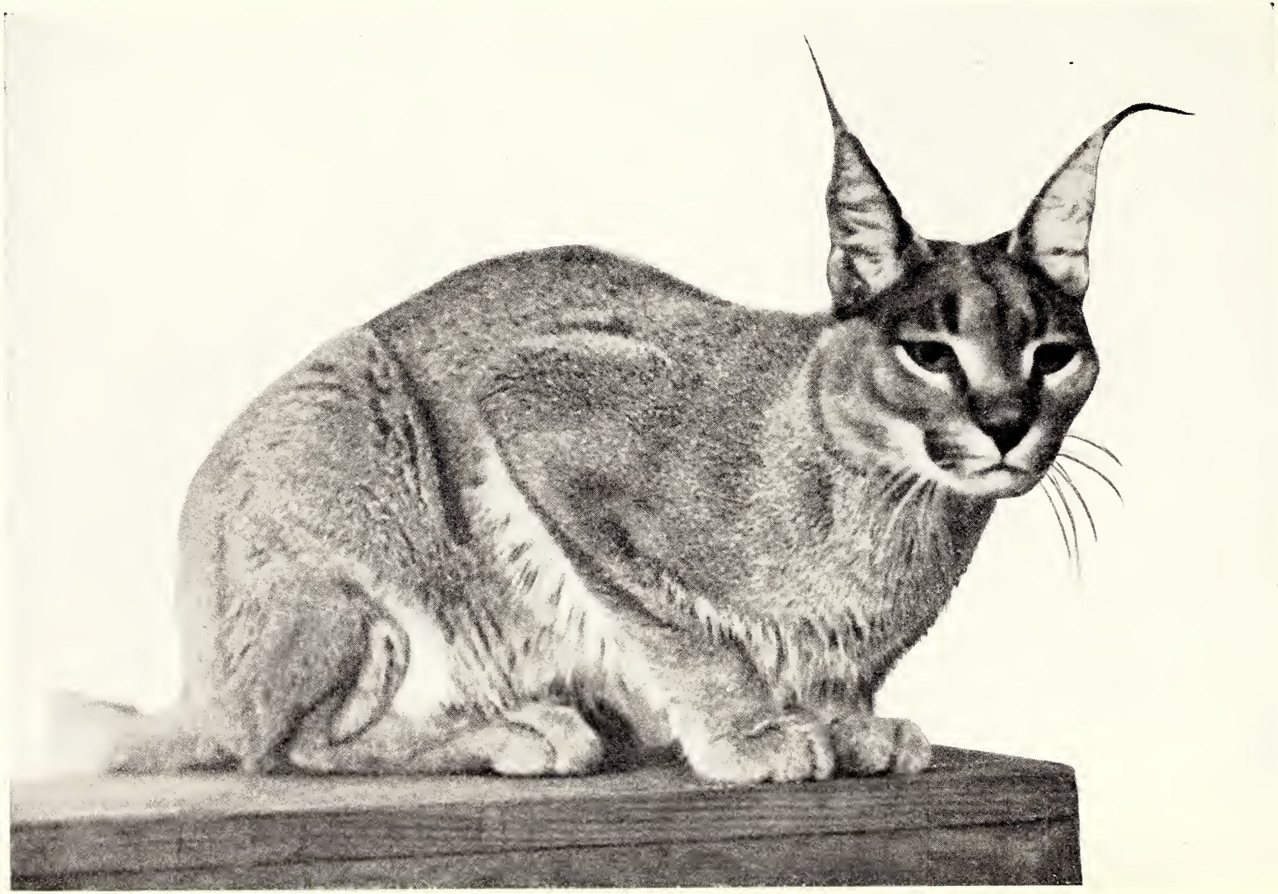


Photo by *W. S. Berridge.*

The Caracal (*Lynx caracal*, Güldenstadt).

act by hunger—it was in a very emaciated condition—or, that it made the attack in error. A captive caracal in the Mysore Zoo killed and partly ate a large cobra which had entered its cage.

Like the Cheetah, it is easily tamed and trained to show its prowess in hunting small deer, gazelle, hares and foxes and also birds such as peafowl, crane and pigeon. It relies for success upon its extraordinary agility. So perfect is the sympathy of eyes and feet, that champion performers in this sport, still popular in Persia, will kill 9 or 10 of a flock of feeding pigeons before they can leave the ground. It is interesting to note that of all the species of cats the Caracal comes nearest to the Hunting Leopard in the structure of its hind feet. It is trained to hunt in much the same way as a Cheetah, whose wide hind feet are better-fitted for securing a firm hold upon sandy ground and for traversing it more swiftly and surely than are the softer more pliable feet of other members of the cat tribe.

Nothing definite is known about the breeding habits of the animal in India. It is said to rear its young in porcupine burrows, in hollow trees or crevices among rocks—the average litter being 2-4.

PALLAS'S CAT (*TRICHAELURUS MANUL* PALL.).

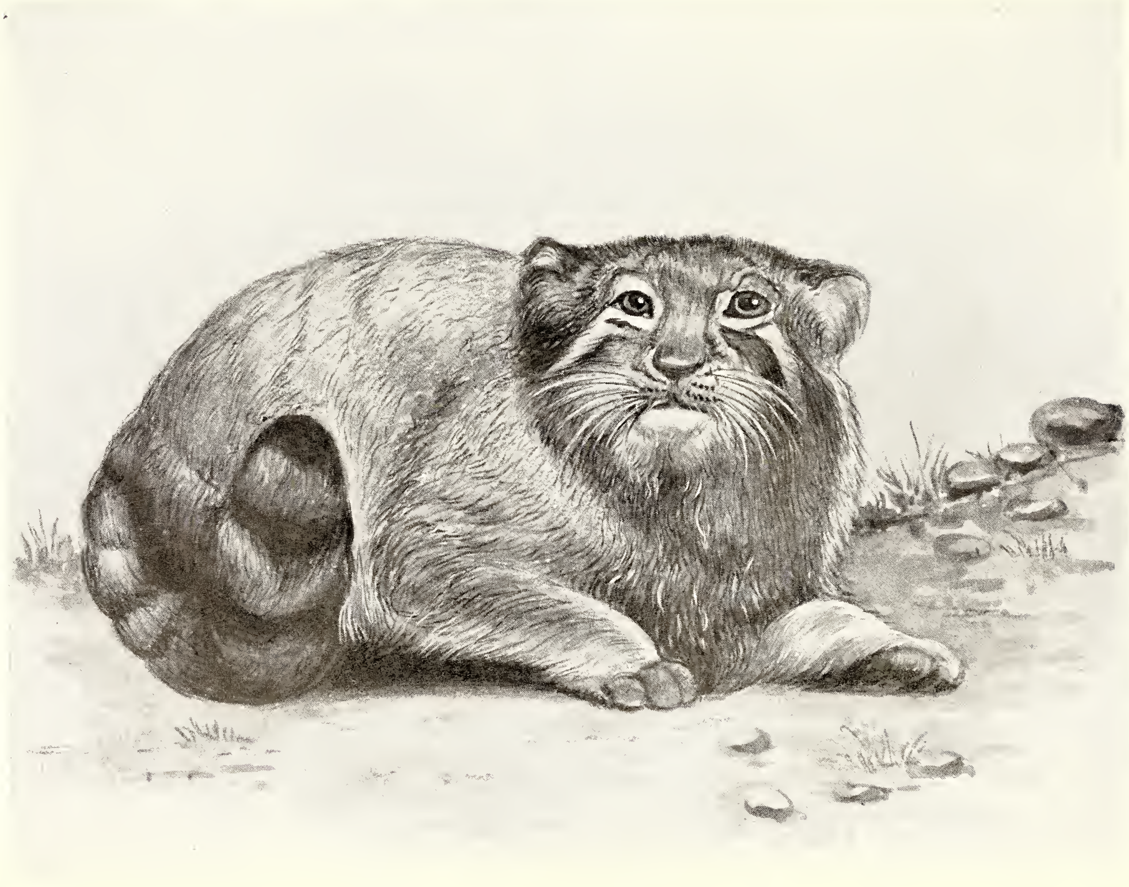
Pallas's Cat is a Central Asian species. Three forms of this cat are known—the typical race is from Turkestan and Western Siberia, a second is found in Mongolia and Siberia east of Lake Baikal and the third known as *Trichaelurus manul nigripectus* Hodgs. occurs within our limits in Ladak and Tibet. Though distinguished by a number of structural peculiarities, Pallas's Cat holds in some aspects a position intermediate between the Lynxes and the true cats (*Felis*).

It is a small, long-tailed cat with a broad head, low forehead and short widely-separated ears, which appear to be set very low behind the cheeks and give the cat a strange and peculiar aspect.

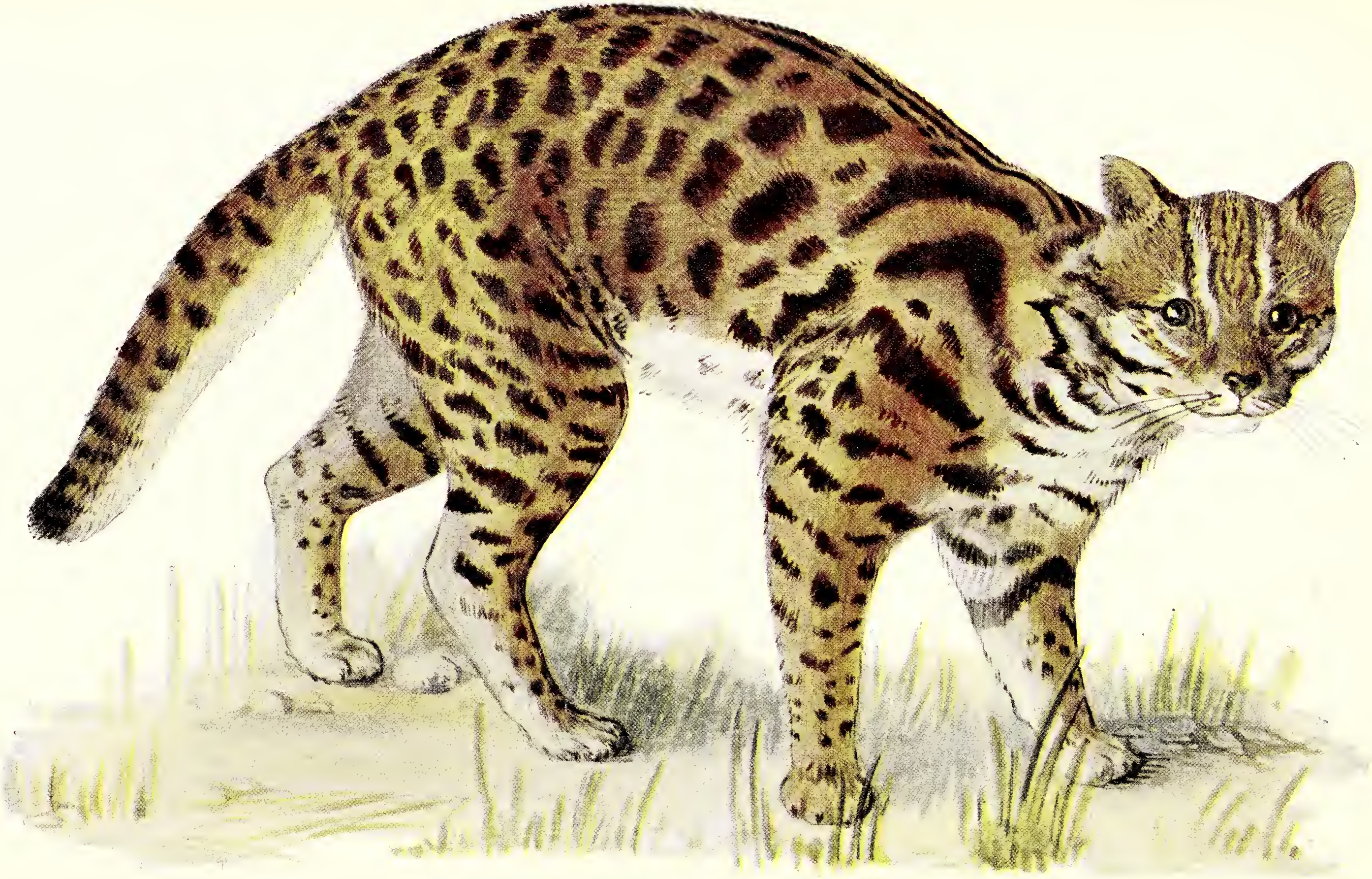
Observation of the behaviour of a specimen in captivity suggested an explanation of its low forehead and the peculiar set of its ears. When watching its prey behind some rock or point of vantage—this species need not lower its ears in the accustomed manner of cats. It is able to reveal a relatively small part of its head without depressing or partially folding its ears—a habit which must to a certain extent interfere with quick hearing in other species.

The prevailing colour of the face of this cat is grey, that of the neck, back and body silvery or iron grey. The hairs on the back are sooty black at the base, then white, and again black at the tip. Traces of dark transverse stripes appear on the loins and sometimes on the limbs. The distal portion of the tail is ringed and ends in a black tip. The fur of the throat, chest, belly and thighs is considerably longer than on the flanks. It is perhaps an adaptation, which gives protection to the cat when lying or sleeping on snow-covered or frozen ground. A parallel lengthening of the hairs on the thighs and under parts of the body is seen in the Yak which, like Pallas's Cat, is a denizen of the bleak uplands of Ladak and Tibet.

Nothing is known about the habits of this cat in the wild state. It is said to live among rocks and to prey on small animals and birds. In captivity, its behaviour was distinctive from that usual in most other small felines. It showed no fear of spectators or a desire to avoid them and was very silent never uttering the familiar snarling growl or hiss. Its mew is described as recalling a 'combination of the bark of a small dog and the hoot of an owl'.



Pallas's Cat (*Trichaelurus manul*, Pall.)



The Leopard Cat (*Prionailurus bengalensis*, Kerr.)

THE LEOPARD CAT (*PRIONAILURUS BENGALENSIS* KERR): THE RUSTY-SPOTTED CAT (*PRIONAILURUS RUBIGINOSUS* GEOFFR.).

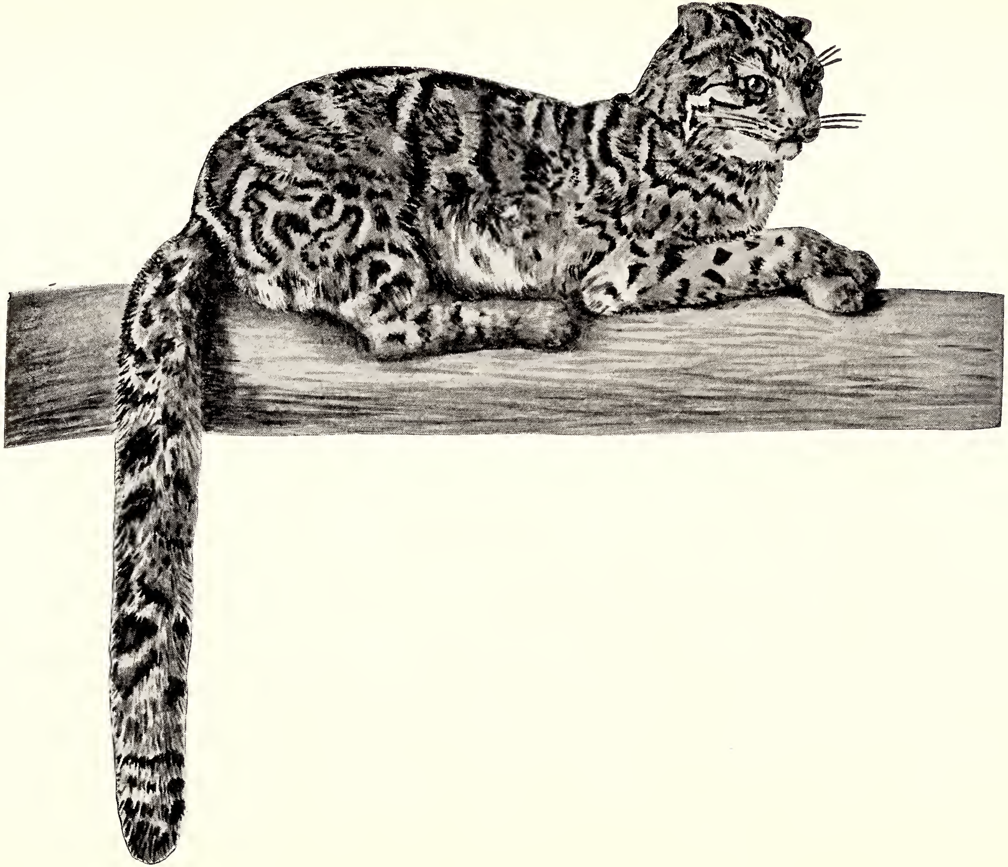
The Leopard Cat was originally described from a specimen which swam on board ship in Calcutta—hence its traditional name *bengalensis*. It is found in evergreen and mixed forests practically all over India—in the Himalayas, the Eastern and Western Ghats and in South India. It is recorded from Kashmir and South Baluchistan. Eastwards from Assam its range extends through Burma and Southern China into the Malay countries.

Rounded black ears marked with a white patch on the outer surface distinguish both the Leopard Cat and the Rusty-Spotted Cat from other cats of the genus *Felis*. The Leopard Cat is about the size of a domestic cat but rather longer in the leg. Its colour and markings give it the aspect of a miniature panther. The prevailing colour of the body is yellowish above, white below, ornamented throughout with black or brownish spots. Both colour and pattern are very variable in the species, the ground colour may show a tendency to grey or rufous and the spots, usually arranged to form regular lines along the body, may coalesce into uninterrupted longitudinal bands. Among other markings are four more or less distinct bands running from the crown over the neck, which break up into short bars and elongate spots on the shoulders. There is a pair of horizontal cheek stripes, the lower joining a black bar across the throat and the usual two black bars on the inside of the fore-arm. The spots on the tail form cross bars towards its end.

This beautiful forest cat preys upon small birds and animals. It is nocturnal in habit and seldom seen. The Society's collectors found it common about villages in Coorg where it is said to be very destructive to poultry. It has 3 or 4 cubs in a litter. A kitten a month old was taken in August in the Niligiris. It became quite tame and though driven off by domestic cats returned more than once to its owners after a sojourn in the forest.

The Rusty-Spotted Cat (*Prionailurus rubiginosus*) is about half or three-quarters of the size of a domestic cat. It is a slightly built active creature with a soft, smooth, fawn grey coat, patterned with brown bars and spots arranged in more or less regular lines. The markings on its head and shoulders are dark brown; they change to rusty on the flanks and are reduced to smaller round spots on the hind quarters. The underparts are nearly white with black spots. Length of body nearly 17 in., tail half the length of the body, weight about 3 lbs. It is found in Southern India and is recorded from the hill forests of the Western Ghats at Khandala in the Poona District, and from Seoni in the Central Provinces. It is common in jungles over the whole island of Ceylon. This elegant and agile little cat lives both in forest and grasslands—in

Ceylon it is rarely seen away from jungle. It shelters by day in holes in trees or under bushes, and hunts by night preying upon small birds and mammals or on poultry, when living near villages. The female has a litter of 2-3 young and conceals them in a hollow log or tree.



del. O. F. *Tassart.*

The Marbled Cat (*Pardofelis marmorata,* Martin).

THE MARBLED CAT (*PARDOFELIS MARMORATA* MARTIN).

This beautiful cat, one of the rarest of all its tribe in museum collections is found in the forests of the Eastern Himalayas and Assam from whence its range extends into Burma and the Malay countries. As a genus, the Marbled Cats are distinguished from the Leopard Cats and their oriental relatives by structural peculiarities of the skull which among other points of distinction is short and broad, more rounded and has wider cheek arches. The teeth especially the canines are relatively more robust and the chin more vertical.

Three races or forms of this cat are known. The East Himalayan race, described under the name *Pardofelis marmorata charltoni* from a specimen taken at Darjeeling, is found in Sikkim and Assam. How far this particular race extends into Burma is not known. The Himalayan Marbled Cat is said to be quite distinctive in its thicker, longer, rich ochreous brown coat whose luxuriance tends to obscure the 'marbled' pattern more apparent in typical examples from Java and Sumatra.

The general pattern on the coat of these cats consists of stripes on the crown, neck and back, of large and small blotches, making the so-called 'marbling' on the flanks and of spots on the underside of the limbs and on the tail. The marbled pattern on the flanks is variable even in cats inhabiting the same region. In the Himalayan race, it is limited to a few, wavy greyish buff stripes which break up the ground colour of the flanks into large ochreous brown patches. The heavily spotted legs are of the same rich hue as the body. The tail is darker in tone and its pattern is obscurely defined. Though much smaller in size, the Marbled Cat resembles the Clouded Leopard in colour and pattern so that young Clouded Leopards are easily confused with this species.

Nothing is known about the habits of this cat. It is conjectured that it is a purely forest cat of arboreal habit. A supposition supported by the structure of its feet which show no adaptation to ground dwelling habits. Its tree climbing and nocturnal habits are suggested as a reason for its rarity in most collections.

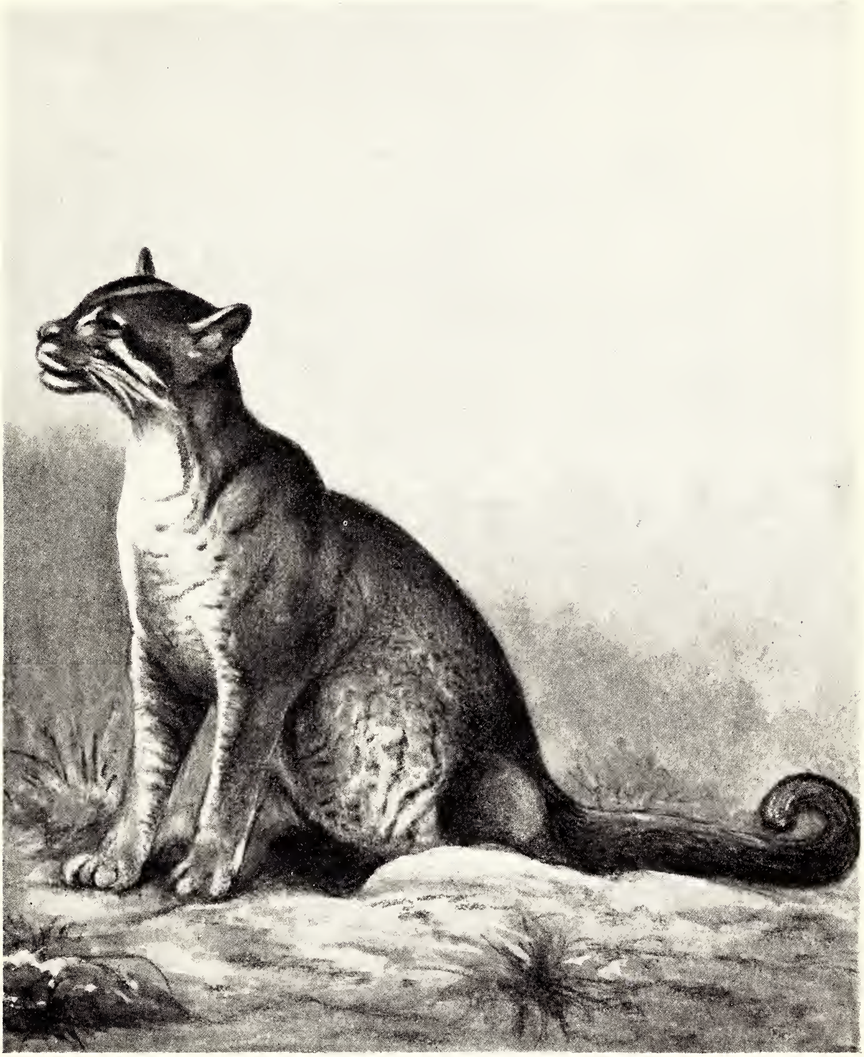
THE GOLDEN CAT (*PROFELIS TEMMINCKI* VIG.).

With the exception of the Clouded Leopard, the Golden Cat is the largest of the group of smaller Oriental felines (*Felinae*). It is a fine sturdily-built cat reaching nearly 5 ft. in length. The typical form of this cat (*Profelis temmincki temmincki*), distinctive in the shortness and sleekness of its coat and the absence of body markings, comes from Sumatra—from whence its range extends into the Malay Peninsula, Indo-China, Siam, Burma, Assam and the Eastern Himalayas. Golden Cats inhabiting more northern latitudes in South-Eastern Tibet, Southern and Western China are said to be distinguished by a greater luxuriance of fur; while one form from the interior of China is distinguishable by its pronounced body markings, which form bold lines and large rosettes.

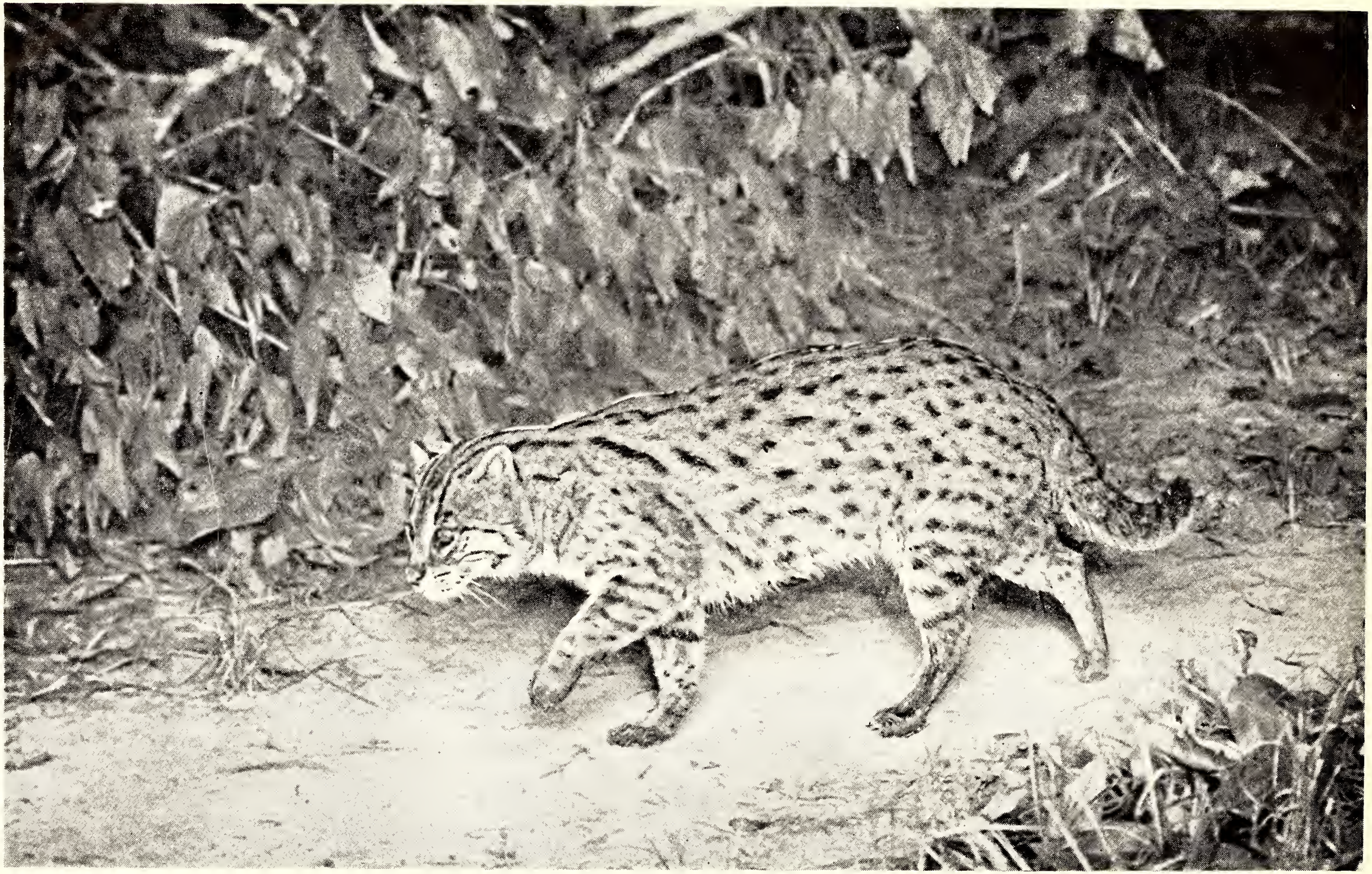
The general colour of the typical Golden Cat varies from golden brown to dark brown, bright red and grey. Black examples are also known. There is usually little or no trace of pattern on the body, when the coat is short and smooth there may be a more or less distinct pattern of greyish lines on the flanks and shoulders. It is suggested that the uniform colouring of the animal without markings is a result of the enlargement and subsequent fusion of blotches and the obliteration of the paler interspaces. Kittens have longer and thicker coats than the adults but show no pattern. But whether the body pattern in the adult is retained or lost, it is always conspicuous on the face of this cat giving it a very striking aspect. Most conspicuous is a horizontal white or buff cheek stripe, sometimes edged with black running from below the eye to behind the gape. On the inner side of the eye there is always a whitish stripe which bifurcates above and is continuous with a more or less distinct greyish stripe passing on to the crown. Occasionally there are curved lines running back from above the eye to between the ears.

Nothing definite is known about the habits of this cat. The Mishmis say that it breeds in hollow trees and has two young. The Lushai hunters state that it lives among rocks and does not climb trees. There is however a record of one which took refuge in a tree from a dog. It did not display the fierceness usually ascribed to this species, which in Burma is known as *Kya Min*, signifying that it dominates other cats even tigers!

The Golden Cat preys on poultry, sheep and goats and small deer. One was shot near Maymyo on a calf that it had killed; another was speared at Victoria Point, Mergui, after killing a buffalo calf.



The Golden Cat (*Profelis temmincki*, Vig.)



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The Fishing-Cat (*Prionailurus viverrinus*, Bennett).

THE FISHING CAT (*PRIONAILURUS* OR *ZIBETHAILURUS VIVERRINUS* BENNETT).

The Fishing Cat inhabits forest and swamps at the base of the Himalayas as far west as Nepal. It is found in parts of Bengal, the United Provinces and Sind. It is unknown from the Peninsula of India except in the creeks and backwaters of the Malabar Coast between Mangalore and Cape Comorin. It is found sparingly in the jungles of Ceylon, except perhaps in the dry Northern Zone—in the wetter parts of Burma and Tenasserim, in Southern China and Formosa.

The body of a large fishing cat measures about 2 ft. 6 in. and its tail is about a foot in length. It scales nearly 25 lbs. Short in limb and rather stout in build, its body is covered with short coarse, earthy grey fur, infused with brown. The body markings consist of a series of elongate spots arranged in more or less longitudinal rows. They vary in size and sharpness of definition in individuals. From 6 to 8 dark lines run from the forehead over the crown on to the neck breaking up into shorter bars and spots on the shoulders. The cheeks are greyish white with two usually well-defined horizontal black or brown stripes. Markings on the limbs are indistinct or wanting. The two usual dark bars appear on the inside of the fore-arm. The lower parts of the body are spotted and the tail is more or less distinctly ringed with black.

The Fishing Cat lives in heavy jungle, or in scrub, frequently in grass swamps or in reed beds, about rivers and tidal creeks. It preys on any animal and bird that it can secure and has been known to kill calves and sheep, to carry off dogs and even children. There is the record of a newly-caught male which killed a leopardess twice its size after breaking through the partition which separated their cages. It is given to feeding on fish and fresh water molluscs. Its method of fishing is to crouch on a rock or overhanging bank and to scoop up the fish with a blow of its paw. It does not enter the water in pursuit of its prey. The fore-feet of this cat have moderately well-developed webs between the toes, the claw sheaths are not large enough to completely envelope the retracted claws, the ends of which project considerably beyond the sheaths.

Nothing is known about the breeding habits of this cat. A single kitten was taken from a lair consisting of a beaten down patch among reeds with runs leading to it from opposite sides.

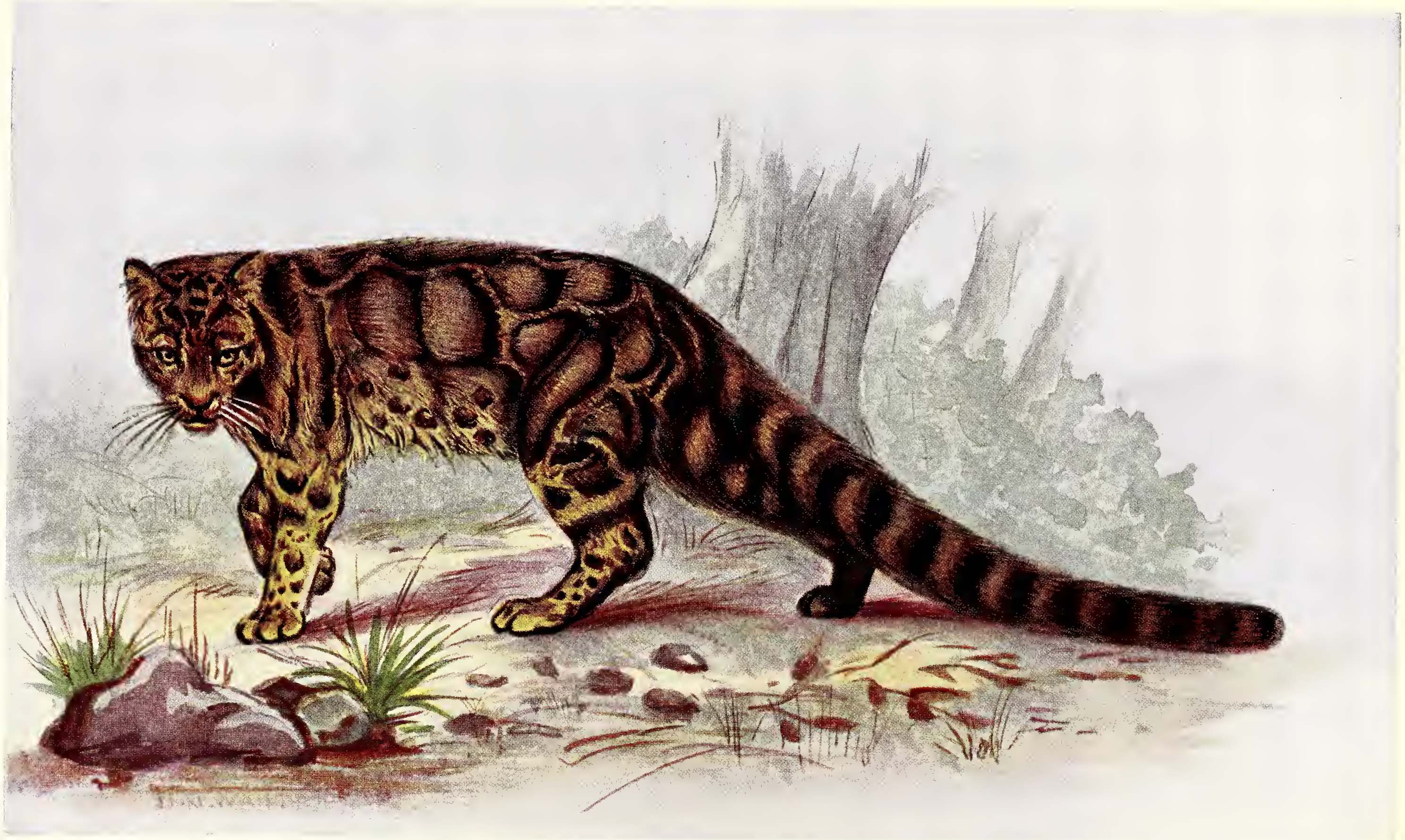
THE CLOUDED LEOPARD (*NEOFELIS NEBULOSA* GRIFFITH).

The Clouded Leopard is found in the forests of Sikkim, Bhutan, in Assam, in the dense evergreen forests in the extreme north and south of Burma, in Siam, the Malay Peninsula and Borneo.

The size of a Clouded Leopard is that of a small panther. A large male measured 6½ ft.; 3 ft. of which consisted of tail. The animal has a long body and tail and short limbs and rounded black ears relieved by a greyish patch in the centre. The structure of its feet is much like that of the panther and its near relatives, the tiger and lion. From the panther it differs in the structure of the hyoid apparatus and in peculiarities in the structure of the skull and the set of the teeth. Very striking is the Clouded Leopard in the enormous relative development of the upper canine teeth, which present the nearest approach among living cats to the great tusks of the extinct sabre-toothed tiger.

The markings of the Clouded Leopard give it a beauty and distinction equalled by a few of its tribe. The general colour of the body varies from grey or earthy brown to pale or rich yellowish brown fading to white or pale tawny on the under-parts. The face is marked with the usual cheek stripes so common in the smaller cats, and the head is spotted. Two broad bands, with narrower bands or elongate spots between them run from between the ears to the shoulders and extend more or less regularly in the form of large oval or elongate marks on the back. The clouded pattern of the flanks is formed by dark blotches more or less lined with black and divided by paler interspaces. The limbs and under-parts are marked with large spots and the tail ornamented with rings frequently imperfect on the sides.

Little is recorded about the habits of this beautiful animal. It is said to be strictly arboreal in habit and to prey on animals and birds after the manner of its kind. There is a record of one which was killed while advancing to attack a herd boy who split its skull with his *dah*.



The Clouded Leopard (*Neofelis nebulosa*, Griffith.)

THE PRESERVATION OF WILD LIFE IN INDIA.

No. 5. THE INDIAN LION.

BY

SIR PATRICK CADELL, KT., C.S.I., C.I.E.

I have been asked by the Honorary Secretary of the Bombay Natural History Society to write a note upon the Indian Lion, and the measures needed for his preservation. I gladly do so because I believe that there is no other wild animal in India which could so easily become totally extinct. It is now preserved solely by the efforts of one State. Should that State for any reason become weary of well doing, the lion would disappear from India in two or three years.

It is not necessary to write at length upon the history of the Indian lion. Two excellent articles on the Kathiawar Lion, written by Lieut.-Colonel Fenton, will be found in the Society's *Journal* of April 1909 and January 1911, and a chapter on the Indian Lion, which summarises most of the available knowledge, may be read in Brigadier General R. G. Burton's *Book of the Tiger*. It is sufficient to say that the lion was once widely distributed over India. Less than one hundred years ago it was common round about Delhi, and it was not very uncommon in Central India and Guzerat not more than seventy years ago. At about the same period it was to be found in the Barda Hills of Jamnagar and Porbandar, while it remained in the Girnar Range near Junagadh City till 1879. Now, however, the lion is entirely confined to the Gir Forest of the Junagadh State. That forest does not extend to 1,500 square miles, as Colonel Fenton says, but to 494 square miles only. The former figure once correctly represented its dimensions, and the late Maharaja Jam Saheb Ranjitsinhji, who spent a good deal of his boyhood within the limits of Junagadh, told me that he had then heard of lions in areas now distant from the forest. The spread of cultivation has very seriously encroached upon the forest and if this encroachment has now been stopped, it has largely been for the sake of the lions. Every one will agree that five hundred square miles is not a great area for the preservation of a species, and, alas, it has not proved to be large enough to prevent the animals straying into other jurisdictions where they have been of late years somewhat ruthlessly shot down.

It should be noted that it has long been recognised that the lion would disappear without preservation, and that it was believed that even with such preservation its extinction could only be postponed. Colonel J. W. Watson, an excellent observer and shikari, when writing the statistical account of Junagadh for the Bombay District Gazetteer about 1880, stated that 'there are probably not more than ten or a dozen lions and lionesses left in the whole Gir Forest', and this in spite of the statement that 'these are strictly preserved'. When Lord Curzon proposed to visit the Gir to shoot a lion, a well known Bombay citizen, who happened to be visiting Junagadh, wrote to a Bombay paper pointing out that there were supposed to be less than a dozen animals surviving. Immediately Lord Curzon was informed of this, he cancelled his shoot, and advised the Junagadh Darbar to preserve the animals strictly. Colonel Fenton writing in November 1908 states that the preservation was not very strict and that the animal was 'slowly but surely approaching extinction' and again that it was 'fast disappearing'.

It was, I believe, entirely owing to the fact that there was a British Administration in the State from 1911 to 1920 with a much stricter preservation of the lion and a considerable amount of co-operation for the time being from neighbouring jurisdictions that the lion has survived, and to some extent increased in numbers.

One of the dangers of the extinction of the lion lies in the comparative ease with which it is shot, and its lack of cunning and finesse as compared with the tiger or the panther. Before I explain the circumstances which make it easy to shoot, I should perhaps state my own qualifications for offering an opinion. I have never drawn a bead upon a lion, but I have been present when some have been shot by State guests. I have also seen lionesses come to tie-ups when a lion was sought by such guests, and have had several tie-ups and beats purely for purposes of observation, and not for shooting. I have of course discussed the matter with local shikaris and others who have seen many lions killed.

The reasons why the lion is a much easier animal to bring to bag than the tiger or the panther are as follows: In the first place, the lion is, as Colonel Fenton points out, a much noisier animal. He will constantly give away his presence by roaring, which a tiger or a panther does not do except for special reasons. Secondly he is in much more open country, especially in the hot weather. The reader of Colonel Fenton's articles will notice that in several cases he was able to stalk lions under trees, and to fire at them when they were resting or lying down. Such a process would be practically impossible with the tiger or panther. Thirdly the lion is much more sociable, and moves about in troops, often comprising three generations. This may not make it easier to shoot a particular animal, but it does make it far easier for the sportsman who is not very particular, to get something, even if it is only a lioness or a half-grown cub. Fourthly the lion, or at least the lioness, if one or more is accompanying the lion, comes out far more readily to a tie-up. In the case of a very good lion, shot two years ago by a visitor from England, the lion came out almost immediately in broad daylight to a goat tied in the open when there had been no previous kill. It is true that, when there are lionesses, the lion, or the principal lion, seems to prefer to send them out first, either to spy out the ground, or to do the work of killing, or perhaps from the more gentlemanly motive of giving the lady the first morsel. In at least three cases, I have known the lioness to come out and do the killing, while the lion has kept in the background throughout. In another case the lioness did a long stalk towards the tie-up, a young buffalo, through a cotton field, and finally lay down within a few yards of it, without attacking it, presumably waiting for the assistance of the lion. She was, however, more patient than we were, and we had to frighten her away when we got down. In a recent case, the lion did come first, and made no attempts to kill, and the lioness came out afterwards and did the killing: but she was a young animal, and the lion seemed to watch her performance with benevolent interest. It is usual to tie-up for lions in the day-time both a goat and young buffalo. The goat is invariably taken first because, as the shikaris say, the lions want to tackle the more serious problem of the buffalo in quiet. Panthers do, of course, occasionally come to tie-ups with extraordinary boldness, but they do not often come, unless they have already killed at the place, with such openness and in such broad daylight as the lions do.

My experience of drives for lions is small, but I should say that, while the lion comes rather faster than the tiger generally does, he gives more notice of his approach, and avoids the open spaces less than a tiger would do. He consequently gives an easier shot.

An obvious cause of their undoing is the confidence of the lions. When they know that they are not often interfered with, they naturally appear more boldly in the open. A good instance of this occurred at our Christmas Camp last year. A lady and a man were riding with an orderly in the afternoon. The lady, riding ahead, came sharply round a corner on a forest road on to a lioness rolling in the dust of the road. The lioness got up, went to the side of the road, and stood there while the riders went past. The remarkable thing was that while the lady's horse started slightly, the other two did not seem to see or mind the lioness. The animal was almost certainly one that we saw in a beat two days later, a very fine lioness of a much more golden colour than is usual with the Kathiawar animal. In another case, a family of lions allowed the inmates of a car to get out and take some cinema photographs of them without any uneasiness.

It is obvious that an animal so easily brought to hand could only be kept extant by strict preservation. This was applied, so far as the Junagadh State is concerned, during the period of Administration, and has since been maintained by His Highness the Nawab of Junagadh. During the Administration, not even a Governor of Bombay, for whom the shooting of a Kathiawar lion had become almost a hereditary 'hukk', was invited to shoot in the Forest. Unfortunately, though the true Gir Forest lies almost wholly within Junagadh limits, the borders of it extend into at least five jurisdictions. At first, with the cordial help of the Agent to the Governor in Kathiawar, the other jurisdictions readily assisted in the work of preservation. The Darbar of one large State agreed originally to drive back into Junagadh limits any lions that strayed across. This abnegation proved too trying for a British Officer who shot several of such animals: but even then it was agreed that only male lions that were actually doing damage should be shot. Now, however, any such restriction seems to have gone by the board.

Lions require a particular environment as a breeding haunt and it is believed that there are no suitable areas outside Junagadh territory. But the animals are easily enticed across the boundary by a succession of tie-ups. It is not only the rulers or officials of these jurisdictions that shoot the animals, but the practice has now begun in one jurisdiction at least of inviting guests from long distances to shoot the lions. One of these guests assured me that he only enjoyed watching the animals. This may have been his only enjoyment, but I was afterwards told that he had shot a young lion and two lionesses. To our certain knowledge, because the news of the slaying of an animal rapidly spreads, twenty-two animals have been so slain within the three seasons ending in 1934. There may have been more but there certainly have not been less. Now it must be agreed that the lions do stray voluntarily, apart from enticement. This occurs particularly during the rains, when insects are bad in the Gir. At that time, however, there is little shooting. Doubtless, however, the lions do damage occasionally: but they would easily be frightened away, if the full-grown males were shot, and no great damage would be done to the stock of lions thereby. No such restriction is observed in practice. Perhaps because, as I have noted above, lionesses and half-grown cubs come most readily to the tie-ups, nearly all of the twenty-two animals I have referred to have belonged to these categories. In one case five animals, none so far as I could ascertain of full size, were shot by the young members of one family. In another, four animals, a young lion, two lionesses and a cub were practically ringed in, and were slain, all the four being claimed as falling to the rifle of one young sportsman.

I believe that it is sometimes suggested that the Junagadh State is selfish in trying to restrict, and, as it is alleged, reserve for itself the shooting of lions. If this is so, the selfishness is not personal. His Highness the Nawab, though a keen rifle shot, has shot only one lion during the fourteen years that have passed since he assumed the Government of the State. There is not an official in the State who has fired at a lion. If every year the State has the very real honour and pleasure of entertaining distinguished guests for a lion shoot, it is a distinction which costs a good many thousands of rupees. There is also the steady annual cost of the sums paid in compensation to villagers and herdsmen whose cattle have been killed by lions. When the State hears of people being invited from afar to shoot the lions bred in its limits it cannot be a matter of surprise if the game sometimes seems hardly worth the candle.

I am often asked how many lions still remain in the Gir. As I have said above, there were supposed to be less than a dozen in 1880, and about the same at the beginning of the century when Lord Curzon's visit was cancelled. As a result of the strict preservation during the Administration the number was believed to have increased to fifty, though even in those days poaching was not unknown. It has since been stated in the London *Times*, and the statement is quoted in General Burton's book, that there are now two hundred lions. I believe this number to be greatly exaggerated. The fact that lions move in troops, and that they cover long distances leads to over estimation. If a man sees a troop of six or seven animals, and hears of a similar number some miles away within a few days, he naturally fixes too high a number for the whole forest. My own opinion though it is only a guess is that there are not much more than 75 to 80. It is obvious that this number cannot stand a drain of ten or twelve being shot yearly, especially if the animals so killed outside Junagadh limits are all of young breeding stock.

It may be observed that there is no real excuse for shooting a lioness in mistake for a lion. Even if the shooting of female tigers and panthers were regarded as being unsportsmanlike and reprehensible, the sportsman might well plead that he had not sufficient time, or sufficient knowledge, to distinguish. But he could not truthfully say so in the case of the lioness. A lion which is not easily distinguishable as being such, must be very young and worthless as a trophy to the self-respecting sportsman.

What then is the remedy to be adopted against unfair or unwise shooting? It has been recently proposed in a high official quarter that all the jurisdictions concerned, that is all those which possess or border upon any portion of the Gir Forest, should agree to refrain from shooting within a mile from the boundary of another jurisdiction, and from shooting any but full-grown males. This would lead to some improvement though in two recent cases the condition that the animal shot should be a full-grown male has been, I am informed, somewhat liberally interpreted. But it may be doubted whether this is enough, and I venture to think that it would be better to come to an agreement that the total number of lions to be shot in one year should not exceed some such figure as five or six.

The pressure on Junagadh of suggestions for invitations to shoot lions is, it may be observed, increasing year by year, and the Junagadh Darbar would gladly welcome some such limitation. Unless an agreement is reached, and is faithfully observed, the danger of the disappearance of the lion from the fauna of India, and consequently from its last home in Asia, is obvious.

No. 6. WILD LIFE PROTECTION IN BURMA.

BY

H. C. SMITH,

Deputy Conservator of Forests, Honorary Game Warden.

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I. THE NEED FOR PROTECTION.

General.

Most civilised Western nations have now realised what Burma has yet to learn, namely, that the perpetuation of an indigenous fauna is essential for a country's welfare.

The perpetuation of wild life is impossible under modern conditions without the enforcement of protective legislation. Burma unfortunately has as yet failed to realise the necessity for such protection and unless she takes immediate and vigorous steps to cast off the apathy which up till now has characterised the attitude of her general public towards all matters pertaining to the perpetuation of wild life she will most certainly be too late as irreparable damage will have been done.

Endowed by nature with a wild fauna which in variety, beauty and interest compares most favourably with that of any country in the world it is the bounden duty of the present generation to hand it down to posterity in as complete a form as possible.

In the early stages of the Province's development wild animals and birds of all kinds were plentiful, guns were few and consequently there was little need for elaborate protective legislation or at any rate for its rigid enforcement.

Recent years, however, have seen a marked change in conditions generally, communications have been improved; more country has been opened up; cultivation has been extended, curtailing the area available for occupation by wild life; and an enormous increase in the number of firearms throughout the province has resulted in the indiscriminate slaughter of numerous kinds of animals and birds, especially in the more accessible districts.

Development must, of course, continue and wild life must, just as inevitably, recede before it, but, in a country like Burma, there is no reason why the indigenous animals should not be perpetuated for all time in certain areas without their presence in any way impeding future national progress. Such animals as tigers, elephants and *thamin* are entirely out of place, and their presence cannot be tolerated in the immediate vicinity of human dwellings or intensive cultivation, but in most of the reserved forests of the country their existence is not only welcome but must be considered an important national asset. Wild animals may be destructive to crops but they are generally harmless to man unless man attacks them first and wounds them. Even a tiger except in the rare cases in which he has turned man-eater goes out of his way to avoid man, and people with a true knowledge of the jungle pay very little attention to his presence unless he starts raiding their cattle.

The main reason why so little interest has up till now been taken in the protection of Burma's fauna is undoubtedly that most people are extremely ignorant on the subject. They do not realise that the possession of a number of wild animals and birds is a very valuable asset to the province nor do they realise that the stock cannot last for ever unless certain restrictions are imposed on its destruction.

To the jungle Burman all ideas of protection are not unnaturally entirely foreign and he instinctively looks for guidance in such matters to the educated classes. If, therefore, the latter fail to set the correct example he can scarcely be blamed for his irregularities.

The average villager has always been accustomed to obtain plenty of everything with very little trouble and is quite oblivious of the fact that supplies must soon come to an end unless their use is systematically controlled.

Bamboos, houseposts, thatching, firewood and water he has always been able to get with ease close to his village. Paddy he has been able to grow with the minimum amount of exertion and wild animals and birds he has regarded as things to be killed whenever possible either to provide meat or else because they damage his crops.

It is extraordinarily difficult to make the villager realise that if he goes on wastefully cutting timber and fuel according to no plan there will soon come a time when the supply will run out and either he or his descendants will suffer in consequence.

One of the main duties of educated Burmans should therefore be to help villagers to realise that with the spread of development and increase in population the time has come when the unrestricted exploitation of all kinds of forest produce cannot be tolerated.

Wild animals and birds are a very valuable form of forest produce and need to be conserved every bit as much as bamboos, timber and fuel.

If only people from Burma could see for themselves the conditions existing in parts of India and other countries where development has already advanced much further than it has at present in Burma and note the distress which has been caused by the wholesale destruction of forests and all that they contain, they would most certainly wake up and take steps now lest the countryside of Burma should share a similar fate.

While it should be a comparatively simple matter to make the villager understand the necessity for the maintenance of a continuous supply of timber, fuel and bamboos, it may not be quite so easy to persuade him that the preservation of a stock of wild beasts is equally advantageous.

Certain wild animals have from time immemorial damaged his crops, killed his cattle and at times also endangered his life and he has therefore, grown up to regard them as his natural enemies to be killed whenever and however possible. Other wild creatures, though quite harmless, he has regarded as meat, of which he has always tried to obtain as much as possible in the easiest way.

Reasons why Wild Life should be protected.

In any country the perpetuation of an indigenous fauna is necessary for commercial, agricultural, scientific, aesthetic and sporting reasons. In Burma the precepts of the Buddhist religion must surely provide an additional cause for protection.

A large portion of Burma's wealth is derived from timber which cannot be economically extracted without elephants. These animals cannot live for ever and a supply of wild elephants must always be maintained from which the domestic herds can be replenished and increased as trade expands.

A considerable amount of revenue is realised annually on account of license fees and royalty paid on the collection of various parts and products of wild animals. There is no reason why this revenue should not be greatly increased with careful management without the fauna being in any way adversely affected.

An immense amount of good is done by many kinds of birds by destroying insects and other pests which would otherwise prey upon crops, domestic animals or human beings. Woodpeckers, owls, nightjars, egrets, drongos, rollers and mynas, are particularly useful in this respect.

A vast amount of information of use to science has been acquired in the past from the study of wild animals and a great deal more awaits discovery. The stocks of specimens in museums throughout the world will not last indefinitely and must therefore be periodically replenished.

Most wild animals and birds add very considerably to the beauty and interest of a countryside by their presence. A country devoid of all wild life, is unnatural, and under such conditions the national character must be adversely affected.

The study of the habits and ways of wild creatures provides one of the healthiest and most beneficial forms of amusement for the people and needs all possible encouragement. Townspeople have few opportunities to study wild animals in their native haunts and have therefore to be content to do so in Zoological Gardens and National Parks. These institutions are increasing in popularity all over the world and their stocks of wild animals and birds will require periodical replenishment.

The pursuit of certain wild creatures *in strict accordance with the dictates of sport* provides one of the finest forms of training for the country's youth and of recreation for its manhood. Individual skill and physical prowess are involved in the location and coming to close quarters with most kinds of wild animals. Perseverance, patience, ability to overcome hardship and difficulty, power of endurance and mental and physical fitness are all virtues which are cultivated and fostered by the pursuit of wild beasts and since these are the qualities which go to make the ideal citizen or soldier every effort should be made to induce the youth of the country to acquire them.

It is the overtaking and the outwitting of an animal which provide the training and the recreation and it matters little whether observation, photography or killing is the ultimate object. To Buddhists whose religion forbids them to take life the first two objects will naturally appeal whilst others will probably wish to kill to obtain a trophy.

II. LEGISLATION.

Existing Legislation.

The legislation at present in force for the protection of the fauna of Burma consists of the following:—

(i) The Burma Game Rules, 1927, together with certain notifications and special orders issued under them. These are all issued under the authority of the Burma Forest Act, 1902.

(ii) The Wild Birds and Animals Protection Act, 1912, which applies to the whole of British India.

(iii) The Indian Arms Act which provides for the control of guns and cartridges used against wild animals and which is also an all-India Act.

These laws together with certain other matters of interest to sportsmen are contained in a *Burma Game Manual* which is on sale to the general public at a price of twelve annas.

Also, since the regulations have necessarily been written in much detail and in legal phraseology which may not be readily understandable to some, an abstract containing their salient points but having no legal significance has been compiled. This abstract which is in the form of a pamphlet entitled *Game Law in Burma* has been prepared in both English and Burmese for general circulation *gratis* in the Districts.

The existing laws whilst making adequate provision for the destruction of wild animals which are a menace to human life and property, for the obtaining of scientific specimens and for the killing of game for sport should, if only they are enforced, afford reasonable protection to the fauna of the Province.

In *bona fide* defence of life or property any person may kill a wild animal in any way he pleases.

The killing of game for the purpose of sport is controlled by the issue of game licenses, particulars of which can be obtained from any Divisional Forest Officer.

It is illegal to hunt any kind of wild animal or bird inside a reserve forest or game sanctuary without a game license.

All wild animals and birds except the following, namely rhinoceros, tapir, buffalo, *mythun*, elephant, bison, *saing*, serow, goral, Argus pheasant, bittern, crane, drongo, egret, heron, hornbill, kingfisher, nightjar, oriole, owl, roller, stork, tern and woodpecker may be hunted anywhere outside reserved forests and game sanctuaries without a license but subject to the conditions of the schedule of close seasons which is reproduced in full below:—

THE SCHEDULE OF CLOSE SEASONS.

No one may hunt any animal or bird mentioned in column 1 of this Schedule during the period mentioned as its close season in column 2 whether inside or outside a reserved forest with or without a license.

1.	2.
Males and Females of :— Rhinoceros Tapir Buffalo *Mythun* Females of :— Elephant Bison *Saing* *Thamin* Hog Deer Sambhur Males of :— All species of deer, if hornless or with horns in velvet.	... The whole year.
Males and Females of :— Serow Goral *Gyi*	... 1st July to 31st October.

The Argus pheasant and all species of :— Bittern Crane Drongo Egret Heron Hornbill Kingfisher Nightjar Oriole Owl Roller Stork Tern Woodpecker	... The whole year.
All species of :— Peafowl Pheasant (other than Argus pheasant) Partridge Painted Snipe Plover Quail	... 1st March to 31st August
All species of :— Jungle Fowl	... 1st April to 30th September.
The Masked Finfoot and all species of :— Duck Teal Moorhen Jacana Watercock Grebe	... 1st May to 31st August.

Note—(i) Special licenses are issued for kheddah operations.

(ii) Immature males of elephant, bison and *saing* may not be hunted at any time.

Mature males are defined as follows:—

Elephant.—Either tusk measured along the outer curve must project at least thirty inches from the gum or must exceed fourteen inches in girth.

Bison.—The horn must measure at least twenty-two inches along the outer curve or must show clearly defined transverse corrugations extending for at least four inches from the base.

Saing.—The horn must measure at least twenty inches along the outer curve or must show clearly defined transverse corrugations extending for at least four inches from the base.

Under Rule 4 of the Burma Game Rules certain methods of hunting are prohibited and except when animals are actually menacing human life or property no one may—

(*a*) shoot any animal with poisoned arrows;
(*b*) lay down poison for any animal;
(*c*) net wild water birds;
(*d*) hunt any animal by means of pitfalls;
(*e*) hunt within one hundred yards of the compound of a Buddhist monstery;
(*f*) hunt any animal during the period shown to be a close time for that animal;
(*g*) shoot any animal other than carnivora from any platform or machan;
(*h*) use artificial light for the purpose of hunting any animals other than carnivora;
(*i*) shoot animals other than carnivora from the back of an elephant or from any kind of vehicle;
(*j*) sell or buy, or offer to sell or buy or possess or destroy the eggs of any of the birds mentioned in the schedule at any time of the year; and
(*k*) hunt any animal named in the schedule for purposes of trade except elephants which are hunted in accordance with a special license.

Under Section 3 (b) of the Wild Birds and Animals Protection Act, it is unlawful in respect of any wild bird or animal for which a close season has been declared in the schedule of close seasons, to sell or buy or offer to sell or buy or to possess any such bird or animal which has not been captured or killed before the commencement of such close time, or the flesh or any other part thereof.

Under the Indian Arms Act it is illegal for anyone to lend a gun or rifle or supply cartridges to any person unauthorised to possess them.

Revision.

In 1925 in view of the increasing number of firearms and the development of the country, the Game Rules then in force were found to be inadequate to safeguard the fauna against serious depletion. A thorough revision of the Game Rules was considered necessary and the appointment of a Game Warden was found to be essential for the proper protection of the wild fauna. The Game Rules and the special orders and circulars under these rules were accordingly revised; the capture and control of wild elephants were systematized and a Game Warden was appointed.

The Burma Game Rules, 1927, came into force on the 1st November of that year and it was laid down that they should be revised after five years. They are now due for revision and since there are many points requiring consideration the matter should receive attention as soon as possible. At the same time, all existing legislation for the protection of the fauna should be thoroughly scrutinized by a body of men representative of commerce, agriculture, forestry, science, sport, religion and aesthetics.

A revision of the Game Rules will entail, amongst other things re-editing the *Burma Game Manual*, the Game Law pamphlets and the various Game licence forms, all of which work should be undertaken by a whole-time Game Warden who at present does not exist.

In 1931 as a measure of retrenchment the post of Game Warden was suspended. Financial stringency cannot justify such a retrograde step in regard to a post on which the total annual expenditure was approximately £1,000 irrespective of compensating revenue.

The rehabilitation of the post of Game Warden is essential if the progress made with wild life protection during the past five years is to be maintained.

A Wild Life Protection Act for Burma.

The Burma Forest Act of 1902, under the authority of which the Burma Game Rules, 1927, are issued only applies to reserved forests and public forest land. It is not applicable to private land.

The Wild Birds and Animals Protection Act, 1912, an all-India Act, applies to private land but no particular class of officer is responsible for its enforcement.

These two disadvantages were fully realised in 1926 when a new draft Act for Burma incorporating the pertinent portions of both the above Acts was drawn up, but never pressed for in the then newly constituted Legislative Council. The need for such an act has not lessened during the past five years and the Burma Game Rules and Wild Birds and Animals Protection Act should now be replaced by a special Wild Life Protection Act for Burma.

Necessary Amendments.

During the past five years a number of weak points in the existing rules have been shown up and certain amendments deserving consideration have been proposed. At the time of revision all criticism whether it be of a constructive or destructive nature should be carefully considered by a representative body.

The most urgent requirement at the moment is legislation to control the exposure for sale or barter of all wild animals or birds or parts thereof at all times and in all places. Until such legislation is introduced and enforced it will be practically impossible to prevent the netting and snaring of wild fowl for trade purposes which is carried on extensively to the accompaniment of great cruelty.

The schedule of close seasons requires careful scrutiny mainly with a view to removing petty inconveniences to sportsmen and making things still simpler for the uneducated.

Close times have been fixed so as to coincide as far as possible with the breeding seasons of the scheduled animals and birds using a minimum number of dates to avoid unnecessary complication and with due consideration for the requirements of sportsmen. In Burma, where certain animals breed the whole year round and birds of one kind or another lay their eggs in every month of the year, the compilation of an effective schedule on these lines is not easy.

The young of Barking Deer (*gyi*) may be born in any month and so these animals were given an arbitrary close season from the 1st of July to the 31st of October, this being the period during which it was thought that fewest sportsmen would be in the jungle. It now appears that many people like to spend their October holidays shooting and are inconvenienced, probably unnecessarily, by October being a closed month for *gyi*. If the existing close season for the males and females of serow, goral and *gyi* were altered to the 15th June to 30th September, many sportsmen would be satisfied whilst the animals in question would be none the worse off.

In 1926 the list of birds included in the schedule underwent close scrutiny and was considerably simplified, nevertheless, further modification is now necessary. The list, which as it now stands, includes approximately 260 species and sub-species, should again be carefully scrutinised by a representative body. An authoritative list of the Burmese names of all scheduled birds should be compiled.

In addition to the above proposals a number of minor amendments have been suggested many of which deal with technical points in connection with the administration of the rules. All these should receive due consideration as soon as a Game Warden and a representative body competent to deal with the situation can be appointed.

The Enforcement of the Laws.

In the past, the non-enforcement of certain protective measures was, to a certain extent, justified by conditions prevailing at the time, but now it is necessary to emphasize the fact that nothing short of a very strict observance of all such legislation in future can save the fauna from serious depletion and the province from a lasting reproach in consequence.

It is, of course, unreasonable to suppose that laws which have hitherto not been strictly enforced can all at once be enforced or that the apathy which has uptill now characterised the attitude of the general public towards Wild Life Protection can, at a moment's notice, be converted into an enthusiasm for the furtherance of such a cause. Nevertheless, it is hoped that when the change in conditions is realised the whole community will take up wholeheartedly the question of the protection of its wild fauna.

In Burma the executive department so far as the protection of the fauna is concerned is the Forest Department and Forest Officers supervise the regulations for the protection of Wild Life in their jurisdictions to the extent to which they take an interest in the matter and have the time to do so. This position may be unsatisfactory but, under existing conditions, it is possibly the best that can be attained.

A Forest Officer's duties give him exceptional opportunities for observing the conditions relating to wild life and for developing a sympathetic interest in the preservation of the wild fauna. It might be supposed, therefore, that the Forest Department would contain a large proportion of field naturalists and lovers of nature yet the hard fact is that only a small percentage of Forest Officers have anything but a superficial knowledge of the fauna in their forests or evince any real enthusiasm for affording it adequate protection. Naturalistic ability and interest in the wild fauna are not part of the compulsory equipment of Forest Officers and a progressive policy in respect of Wild Life Protection involves additional work which is neglected by a larger proportion of the Forest Establishment than might be expected.

In the majority of cases the local heads of Forest Circles and Divisions in common with many senior officials of other Government Departments, are men from overseas whose interest in handing down to posterity an undepleted fauna can in no way approach the viewpoint of the average colonial. This migrant official personnel to whom is entrusted the control of all matters affecting the fauna, however conscientious it may be in regard to the work for which it has been trained, cannot as a whole, raise sufficient enthusiasm over an optional interest in a country in which it has no intention to settle permanently.

Modern conditions of service have aggravated the situation and there is a growing tendency amongst officials to dissociate themselves from any but those matters which are part and parcel of their contracts and agreements. Increased office work often makes it impossible for district officials to spend sufficient time on tour and Forest Officers, with many special duties to perform in connection with their appointments, cannot usually devote sufficient time to the supervision of regulations for the protection of wild life which is frequently in parts of the country where forestry operations are practically non-existent. Leisurely touring in remote areas, which is so essential for effective Wild Life Protection and also incidentally, for the proper administration of a district, is no longer encouraged.

Within the last three years the situation has been further aggravated by the rebellion in Lower Burma and the economic crisis which has affected the whole Province. During the rebellion general lawlessness prevailed throughout several districts and in some forests it has only recently been possible to resume normal touring. The financial crisis led to a substantial reduction in the Forest Establishment and to an amalgamation of certain Forest Circles and Divisions. During this retrenchment Wild Life Protection received little consideration with the result that certain Divisional Forest Officers now find that it is quite impossible to enforce protective legislation throughout the vast areas under their charge.

The officers of the Forest Department are most directly concerned with the enforcement of the Game Laws but it is obvious that no matter how enthusiastic they may be, their efforts must be largely nullified unless they receive strong support from members of other departments and the general public as well.

Isolated individual efforts can achieve little in a case like this; what is required is a concerted effort on the part of every one for the attainment of the common end.

At present an active form of public opinion in favour of Wild Life Protection which plays such an important part in the enforcement of the laws in Western countries, is almost entirely lacking in Burma, and until it is created it is unlikely that a great deal of progress will be made. Its creation, however, should not prove a difficult matter if every sportsman in the country would make up his mind once and for all to adhere rigidly to the letter of the Law himself and make a determined effort to see that his subordinates and followers do the same. If all such men would learn to regard the non-observance of the Game Laws as unsporting and those who infringe them as persons not playing the game the desired form of public opinion would soon be created.

Ignorance of the necessity for protective legislation and even of its existence has undoubtedly often been the cause of numerous infringements in the past, but in these days there can be little excuse for a serious breach of the law at any rate on the part of an educated person.

Under existing conditions the killing of wild animals and birds for food alone cannot be justified, for when due allowance is made for the numbers which must be killed annually in defence of life and property, properly regulated shooting for sport is all that can be tolerated. These facts have been given due weight in the compilation of the existing laws, and if only these are strictly observed there need be little fear of any species ever being irreparably reduced in numbers.

Breaches of the Laws.

The practices of lending out guns and disregarding the close seasons, above all others are responsible for most harm to the fauna.

Many persons possess guns which they have little desire or ability to use themselves but they are nevertheless very fond of meat. They, therefore, lend their weapons to others to procure meat for them. The persons thus employed usually have little regard for the age or sex of their victims and pay little heed to the game laws or the dictates of sport.

The lending of a gun or rifle or giving of cartridges to persons unauthorised to possess them are practices which, besides being illegal, dangerous and unsportsmanlike, are, more than any others hostile to the cause of Wild Life Protection.

In respect of the disregard for the close seasons the plea is frequently brought forward that men who are compelled to spend most of their time in the jungle should be allowed a certain amount of licence regarding the observance of the Game Laws. This is all very well, but in Burma no kind of Game exists in such numbers that its destruction purely for food purposes in contravention of the game laws can be justified.

If every one who earned his living in the jungle was allowed to obtain as much meat as he liked in any way he liked, then the wild fauna would very soon be exterminated.

In addition to lending out guns and non-observance of the close seasons there are other factors the effects of which, though not so far reaching, nevertheless form a considerable menace to the wild life of the country.

Recent years have seen a very large increase in the numbers of domestic cattle owned mainly by Indians. The herds in places have assumed large proportions, and containing as they do numerous weak and sickly animals they foster the spread of cattle disease besides consuming well nigh the entire food supply which belongs legitimately to the draught cattle of the local villages and the indigenous fauna. Every hot weather large numbers of *saing* and other wild animals succumb to disease which apparently originates with domestic cattle, and unless steps are taken to restrict the numbers and wanderings of the prolific herds, many of which appear to serve no useful purpose, considerable harm is likely to result.

Among a certain class of *shikari* the shooting of deer, pig and even *saing* and bison by lying in wait for them in *machans* or in 'hides' built near salt-licks, waterholes, wallows and game tracks is most popular. By this method at certain seasons of the year great destruction can be done, and if the method were to be consistently employed on a large scale game could be practically wiped out of most areas without much difficulty. In a country like Burma which carries such a very small head of game per square mile and in which for several months of the year animals are compelled through scarcity of water and fodder to concentrate round certain definite spots, such a method can never be permitted without the fauna suffering irreparable loss in consequence. Determined efforts are therefore needed to put a stop to these practices and to strengthen public opinion against them.

The shooting of *thamin* from carts and of other animals from the back of an elephant are practices which cannot be permitted. *Thamin*, in certain areas, can be approached comparatively easily in a cart, and most animals will allow an elephant with a man on its back to get to within shooting range before making off, with the result that by the adoption of such methods they can be easily killed.

A modern invention which is instrumental in the destruction of large numbers of hog-deer and to a lesser extent of other animals throughout the province is the electric torch. Its comparatively small cost and the ease with which it can be obtained has placed this article within the reach of all who can handle a gun and the damage which is now being done with it is very considerable. A deer when feeding out in the open at night can be located at a long distance with the aid of a powerful torch and the animal being apparently stupefied will allow the 'sportsman' to walk to within easy gun-shot range of it before making off. The result of this is that fields and open spaces are patrolled at night by men armed with torches and guns, and as many as half a dozen deer are often accounted for by one gun, in a single night. Needless to say, the shooter does not trouble himself about the sex or age of his victims. Many kinds of animals are killed with the aid of torches, but hog-deer probably suffer most.

In certain districts the low-lying areas along the banks of the big rivers become flooded annually during the rains, only small islands of high ground being left above the surface of the water. Wild animals, mainly *sambhur* and hog-deer inhabiting such areas, do not seem to have the sense to leave them before the floods come and become, therefore, marooned on these small pieces of dry land. The neighbouring villagers are quick to take advantage of this fact and sally forth in boats with dahs, spears and dogs, and generally make short work of any animals they find. Many animals are killed in this way every year.

In addition to the illicit methods of killing already mentioned a certain amount of trapping and snaring is always going on, generally practised by jungle villagers with the aid of various primitive and at times most ingenious devices. The amount of damage done in this way is not serious and is in fact negligible when compared with the devastating effects of illicit shooting.

III. Sanctuaries and National Parks.

Most civilised countries have now recognised that no policy of Wild Life Protection can hope to be a permanent success unless it is built on a foundation of secure sanctuaries. Inviolable sanctuaries must be constituted to ensure that a limited number of representatives of every species of an indigenous fauna are perpetuated for all time.

In England there are a number of Game Sanctuaries and additional sanctuaries are continually being constituted. In South Africa and Canada where their national value is perhaps more fully appreciated than anywhere else, sanctuaries occupy thousands of square miles and are visited by over a million people annually. These vast sanctuaries which, besides assisting in the perpetuation of wild life, afford recreation grounds for masses of the population are termed 'National Parks'. People from the cities and large towns flock to them annually in increasing numbers and spend their holidays observing and studying the wild creatures amidst magnificent scenery thus benefiting enormously from the healthy exercise and fresh air.

If only the youth of Burma could be persuaded to divert its attention from the cinemas and less healthy places of amusement in Rangoon and other towns and take a delight in improving its general fitness in a like manner, how very much better it would be for the province as a whole.

In Burma there are at present five areas notified as sanctuaries covering a total area of approximately 400 square miles. This considering the total area of the province and the variety of its fauna is quite inadequate and further areas will have to be notified in the near future if all species are to receive the protection they require.

Burma's existing sanctuaries are as follows:—

Name of sanctuary	Area in Sq. miles	Forest Div. in which situated	Species for which the sanctuary is primarily constituted
Pidaung ...	260	Myitkyina ...	Elephant, Bison, *Saing*, Sambhur, Hog-Deer, *Gyi*, Pig, Tiger, Leopard, Bear.
Shwe-U-Daung	81	Mogok ...	*Rhinoceros sumatrensis*, Elephant, Bison, *Saing*, Sambhur, Serow, *Gyi*, Pig, Tiger, Leopard, Bear.
Maymyo ...	49	Maymyo ...	*Gyi*, Birds.
Moscos Island.	19	Tavoy ...	Sambhur, *Gyi*, Pig.
Kahilu ...	62	Salween and Thaton	*Rhinoceros sondaicus*.

The above statement shows that of the larger fauna *thamin* and tapir are totally unprovided for and any one at all familiar with local conditions will admit the inadequacy of the provision made for rhinoceros, *saing* and hog-deer.

Of the existing sanctuaries, Pidaung and Shwe-U-Daung should be raised to the status of National Parks; Maymyo can never be much more than a Wild Bird Refuge and the Moscos Islands sanctuary is of very little value.

The Kahilu sanctuary deserves special attention. Constituted in 1928 primarily for the perpetuation of a family of *Rhinoceros sondaicus*, it is supervised by two Karen keepers on monthly salaries of Rs. 50 and Rs. 30 respectively. *Rhinoceros sondaicus* is now the rarest large mammal in the world and this sanctuary probably contains the only known living specimens. The local market value of the animals is certainly not less than Rs. 2,000 each, whilst their scientific value is inestimable.

Recently, as a measure of economy, Government dispensed with the services of one of the keepers and seriously contemplated dispensing with the services of the other. Instead of considering relaxation of protective measures Government would be well advised to maintain stricter control over the sanctuary with a view to ensuring effective protection in future.

The preservation of these few surviving specimens of *Rhinoceros sondaicus* is one of more than provincial interest and the question of the future maintenance of the Kahilu sanctuary is one which might well be referred to the Society for the Preservation of the Fauna of the Empire.

Two more sanctuaries are urgently required in Central Burma for *thamin* and these should, if possible, be so selected as to include *saing* and hog-deer as well. One of the areas chosen might be on the Katha-Shwebo District boundary and the other on the borders of Minbu and Thayetmyo. Both these sanctuaries should be constituted with a view to their being raised eventually to the status of National Parks.

In Lower Burma an area should be taken primarily for tapir and it should also provide for rhinoceros, elephant, bison, sambhur and mouse deer. One of the former habitats of *Rhinoceros sondaicus* near the coast in the Mergui District would probably be most suitable for this purpose.

The adoption of the above proposals would result in Burma possessing six effective sanctuaries, four of which could be raised eventually to the status of National Parks; every species of the indigenous larger fauna would be well provided for and the protection of wild life in the province would be placed on a thoroughly sound foundation.

Sanctuaries, if they are to be effective, must:—

(1) be sufficiently large to allow the animals to live in them the whole year round without having to wander outside;

(2) comprise natural game country possessing abundant food, water and cover;

(3) be undisturbed by timber extraction and other forest works;

(4) be sufficiently accessible to permit of frequent inspection by responsible officers and sportsmen;

(5) be sufficiently inaccessible to prevent the animals from being molested and harassed by villagers and others encroaching upon their boundaries;

(6) be free from grazing rights since domestic cattle in a sanctuary spread disease besides reducing the food supply and disturbing the forest; and

(7) possess security of tenure and not be liable to sudden changes of constitution or control. The present system under which sanctuaries are controlled by officials who are continually being transferred and whose personal idiosyncrasies are often unleavened by any permanent and personal interest in the country is most unsatisfactory.

Those sanctuaries which are suitable for constitution as National Parks should be dedicated to the people of Burma for their benefit, education and enjoyment subject to regulations which would ensure that such Parks were maintained and made use of so as to leave them unimpaired for the enjoyment of future generations.

In South Africa the Kruger National Park is controlled by a National Parks Board of Trustees who are not remunerated for their work which is honorary. The possibility of placing all sanctuaries in Burma under the control of a National Trust composed of gentlemen indigenous to the country should be seriously considered. There are probably many educated Burmese gentlemen and many domiciled Europeans and Anglo-Indians who will respond to this suggestion and willingly accept the trust if the situation is brought to their notice. Equally there are certain men from overseas who would abandon every vestige of racial feeling in a common sporting instinct and would assist the Trust. That the Burmese people would react favourably is certain.

For effectual control a National Trust would require a field officer to inspect the sanctuaries and advise the Trust. The transfer of sanctuaries to the control of a National Trust would naturally be gradual and, at inception, should be subsidised by Government and the services of an officer or officers lent to the Trust. In course of time those sanctuaries which are raised to the status of National Parks should be self-supporting and in the meantime the expenditure upon all sanctuaries should be met from an allotment made by Government from the revenues derived annually from the means to destroy wild life.

For the proper protection of all sanctuaries and the development of those selected as National Parks the whole-time services of a suitable officer, responsible to the Trust alone, would ultimately be required. Bearing in mind that the personnel of the Trust would be indigenous to the Province its field representative should, if possible, be a Burman. It should not be difficult to obtain the services of a Burmese gentleman for this post. There must be some who are keen sportsmen and naturalists and the existing records of the work already done in connection with sanctuaries would be of the greatest assistance to him. The Provincial Honorary Game Warden and a few other keen wild life conservationists would probably be only too glad to act at first in an advisory capacity.

The wisdom of handing over such an interest as wild life protection in sanctuaries and parks to the control of an unofficial and indigenous Trust will be doubted by many; but there appears to be no other reasonable alternative. It must be remembered that the formation of such sanctuaries as there are and practically all that has been done for the credit of Wild Life Protection in Burma has been the work of only a very few enthusiasts whose efforts are now in danger of being nullified by the opposition or indifference of officials who have very little permanent interest in the country. The recent history of Wild Life Protection and the forecast suggests that wholly official control on past lines is likely to lead to a worse condition than is the case at present. The introduction of unofficial and national interest may save the situation; at the worst it can hardly lead to worse conditions than those obtaining. It is worth remembering also that an indigenous Trust could sway public opinion and enlist the support of the ubiquitous and often very influential Burmese priests in a manner outside the scope of the overseas official.

IV. SPORT.

From the sportsman's point of view Burma possesses many attractions. There are few Forest Divisions in which fair sport with 'big' and 'small' game cannot be enjoyed whilst in certain selected places the possibilities are excellent.

As the development of the country proceeds and the tenure of all waste land becomes settled the larger fauna must inevitably be forced to take refuge in reserved forests. These State forests are extensive and provided that adequate sanctuaries are constituted on the lines already proposed there is no reason why 'big game' should not be perpetuated to accommodate an almost unlimited number of local and visiting sportsmen without any fear of the stock being seriously depleted.

Since the success of Wild Life Protection in the future will depend very largely upon the education of the jungle Burman it is desirable that sportsmen of the right type should visit the more remote forests periodically and endeavour by precept and example to teach the villager to take more interest in the local fauna and its protection. Nowadays, local officials, however keen they may be on sport and natural history, can seldom spare the time to discuss these matters in the villages and jungle in the way that sportsmen on holiday can afford to do.

Statistics show that the head of 'big game' killed annually under sporting licenses is negligible and hitherto there has been a tendency to discourage outside sportsmen from visiting the Province. Propaganda and advertisement of the country's resources have been neglected until the publication of Mr. Peacock's[1] book there was hardly a modern publication of any real assistance to visiting sportsmen.

The cost to a visitor of one elephant shooting license plus an ordinary Game license is Rs. 450. The fact that a flow of outside sportsmen shooting under a proper system of shooting blocks would not only benefit Wild Life Protection by embarrassing poachers but yield large direct revenues does not seem to have been appreciated. Obviously there would be other attending benefits, not the least being that healthy outside criticism and advice with regard to local protective methods would be forthcoming.

During the period 1927 to 1931 when a Game Warden was in office conditions improved. Visiting sportsmen and naturalists were assisted with advice and information and several expeditions were personally conducted. With the suspension of the post of Game Warden decentralisation in these matters was inevitable. An Honorary Game Warden with no special clerical establishment and heavy Forest Divisional work to attend to cannot devote much time to the assistance of sportsmen and so all progress in this direction has unfortunately been stopped.

V. KHEDDAH OPERATIONS.

The capture and training of Wild Elephants is controlled by a 'Plan of Kheddah Operations for Burma' which has been drawn up for the period 1931-32 to 1939-40. Under this plan certain areas have been closed to operations as elephant sanctuaries, others have been classified as areas in which the extermination of elephants is desirable in the interests of the country's development; the greater part of the province in which wild elephants occur has been divided into a number of kheddah blocks to be worked over in rotation by kheddah licensees.

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[1] 'A Game Book for Burma and Adjoining Territories' by E. H. Peacock, Deputy Conservator of Forests and Game Warden, Burma (retired). H. F. & G. Witherby, 326, High Holborn, London, W. C. Price 12*s*. 6*d*. net.

Prior to the compilation of this plan the control of kheddah operations was decentralised in local district officials, many of whom had but a superficial knowledge of the work and often no time in which to supervise it. This resulted in irregularities, unsystematic work and excessive mortality among the captured elephants. Experience showed that centralisation of control was essential for efficiency and the Plan of Kheddah Operations was drawn up on the assumption that control would be centralised in a Game Warden.

During the short time in which a whole-time Game Warden exercised control, much headway was made. Kheddahs were visited periodically and running records were kept of the work of all licensees. By comparison and a study of the work in different Forest Divisions the Game Warden was able to sum up the resources and capabilities of each licensee. The best men were encouraged and those whose work was consistently unsatisfactory were eliminated in order to make room for new men deserving a trial. The general standard of work was raised and the mortality percentage reduced.

With the suspension of the post of Game Warden progress ceased and control is now once more becoming decentralised in local officers. The Honorary Game Warden cannot supervise Kheddah work in Forest Divisions other than his own; the most he can do is to issue licenses and maintain the records from reports sent to him by Divisional Forest Officers. This arrangement is most unsatisfactory and particularly disheartening to those who have laboured to set kheddah work in Burma upon a sound foundation. Government's accepted policy is to raise the standard of work and to build up a reliable and humane agency for the capture and training of wild elephants. These objects can never be achieved with decentralised control.

VI. Elephant Control.

So long as a stock of wild elephants is maintained in Burma periodic damage to cultivation by herds is bound to occur and individual rogue elephants will, from time to time, cause trouble.

Kheddah operations may do good indirectly by reducing the number of elephants available for doing damage, but they also aggravate the trouble by driving elephants towards cultivation from the more remote forests in which the stockades, to be of any use, must be situated. They also tend to break up herds and scatter individuals and small parties over a wide area.

The present arrangement under which anyone may kill by any means, elephants which are actually damaging crops is open to grave objection. It entails shooting at elephants by night with shot guns and light rifles and wounding elephants in traps. This has the effect of turning otherwise normal animals into rogues which become a menace to human life and are often most difficult to destroy. Similarly the system under which individual rogue elephants may be proclaimed by a Deputy Commissioner is unsatisfactory since it authorises any person to hunt an elephant with any kind of weapon. Great harm results from inexpert and indiscriminate shooting, which is entirely foolish and utterly wrong; nevertheless it must continue until Government removes its excuse by undertaking a properly co-ordinated system of elephant control.

As soon as a satisfactory system of control is in force it will be possible to review the present general exemption given to persons to kill elephants in alleged defence of life and property. It is an established fact that a large percentage of guns which are licensed for crop protection are used for poaching. Many of these guns could be withdrawn provided an efficient system of elephant control was introduced.

Without further delay at least six men should be recruited, trained and kept in readiness to deal with crop raiding and rogue elephants in any part of Burma. These men armed with Government Rifles and working under a set of comprehensive rules should be sent to districts as required. In addition to ordinary crop protective work in the permanent kheddah blocks, these experts would complete the extermination of elephants in those blocks in which extermination is desirable and in which the elephant stock has been reduced to a level at which kheddah operatives can no longer be induced to work. The men should be recruited, trained, paid and controlled by a Provincial Game Warden.

VII. A Wild Life Protection Society.

Attention has been invited to the critical conditions which are affecting the fauna of Burma, the urgent necessity for remedial measures and the ways in which the situation may be improved. Most of the proposals put forward invite action on the part of the local Government, and Government is disinclined to act in matters of this nature in the absence of public opinion. In Burma public opinion in favour of Wild Life Protection is non-existent and until it is created little progress is likely to be made.

Periodically for the last ten years the formation of an Association or Society as an unofficial centre for fostering public opinion in favour of the conservation of the local fauna has been considered. So far nothing has materialised and since the need for such a Society is now greater than ever the sooner the matter is taken up seriously the better.

Ignorance is perhaps the greatest enemy of Wild Life Protection. Ignorance regarding wild animals and birds, their identity, habits, food and utility is general; and people do not care to protect that of which they know nothing.

A provincial Wild Life Protection Society inaugurated by influential nature-lovers and sportsmen, and supported by educated members of all communities, could do an immense amount of good. Such a Society working in collaboration with the Society for the Preservation of the Fauna of the Empire, the Bombay Natural History Society and the Royal Society for the Protection of Birds could, by widening knowledge, evoking sympathy and promoting interest in the local fauna, create and foster a healthy form of public opinion.

The Society should aim at the creation of a public opinion that will demand and support amended legislation for the better protection of the fauna. It should endeavour to gain widespread support from Buddhist priests, teachers, magistrates, property-owners and agriculturists. It should organise educational efforts on the lines of lectures, publications, leaflets and answers to correspondents on questions of food, status, habits, legal protection etc., of wild animals and birds.

A Wild Life Protection Society organised and run as outlined above would give a great impetus to Wild Life Protection and the Province as a whole would benefit enormously from its achievements.

VIII. THE APPOINTMENT OF A GAME WARDEN.

The recent abolition of the post of Game Warden has led to a situation that deserves serious consideration. Financial stringency was no doubt the main reason but failure to appreciate the consequences of that retrograde step was probably the chief cause of the calamity. The urgent necessity for the re-appointment of a whole-time Game Warden has already been stressed and unless action is taken at the earliest opportunity the progress made during the past six years will not be maintained and no further headway will be made with Wild Life Protection in Burma.

The protection and exploitation of the fauna is not the kind of work that can be safely decentralised unless the average executive officer realises that such work is not an optional but a compulsory duty which he must study. Centralisation of the work in a Provincial Game Warden is essential both in the interests of organisation and the education of the executive.

In 1926, in view of the increasing number of firearms and the development of the country the position with regard to Wild Life Protection became serious. A conference was held and it was decided that the appointment of a whole-time Game Warden was essential for the proper protection of the wild fauna.

In 1927 the post of Game Warden was constituted and it was held by a European Forest Officer for three years. At the end of 1931 the post was suspended but the records were maintained by a Forest Officer who was appointed Honorary Game Warden in addition to his normal duties in a Forest Division.

During the period 1926 to 1931 all matters pertaining to the protection and exploitation of the wild fauna, were centralised in the Game Warden. All protective legislation was thoroughly revised, the capture and control of wild elephants were systematised. New sanctuaries were constituted; the reservation of uncultivable land in the interests of the fauna was pushed forward. The question of developing certain sanctuaries in the direction of National Parks was considered, and a growing tendency to treat Wild Life Protection with indifference was corrected. Details of the work done are summarised in the Game Warden's Annual Reports for the years 1929, 1930, 1931 and 1932.

At present, a Forest Officer is appointed Honorary Game Warden in addition to his primary duties as officer in charge of a Forest Division. This is of little use. The honorary appointment carries with it small power to mitigate any but the most flagrant deviations from commonsense practice and the Honorary Game Warden's forest duties leave him with little time in which to deal with protection in divisions other than his own.

IX. Revenue and Expenditure.

It is estimated that the wild fauna, excluding fish, directly or indirectly, produces revenue to the extent of at least, Rs. 1,30,000 per annum.

The sources from which this revenue is derived together with very conservative estimates of the amounts obtainable annually are given below:—

	Rs.
(1) License fees for firearms licenses for sport and for protection against wild animals ...	50,000
(2) Import duties on sporting weapons and ammunition	50,000
(3) Game and kheddah license fees	8,000
(4) Royalty on elephants captured	9,000
(5) Sale of products of wild animals	10,000
(6) Compensation and fines on account of offences against the Game Laws	3,000
Total ...	1,30,000

Trade depression and the general shortage of money may cause a considerable decrease in the revenue obtained from game and kheddah licenses and from the royalty on captured elephants, but, it is doubtful whether the revenues derived from license fees and import duties on account of sporting weapons and cartridges are similarly affected. At present there are probably not less than 20,000 sporting guns and rifles in Burma. All these weapons produce revenue directly or indirectly but although a great deal of money is being obtained from this means of destroying wild life very little is being spent on protection.

Since the Forest Department is responsible for the issue and control of game and kheddah licenses and for the enforcement of protective legislation, a fraction of the establishment charges of that department must be debited to Wild Life Protection. Beyond that, however, all the country is spending annually upon the conservation of a valuable national resource—at present a rapidly disappearing possession—is the sum of approximately Rs. 4,000 which represents the pay of the staffs in the Pidaung and Kahilu Game Sanctuaries.

The constructive proposals now put forward for placing Wild Life Protection in Burma upon a sound foundation entail an annual expenditure of approximately Rs. 50,000 allotted as follows:—

	Rs.
Pay and allowances of a Game Warden ...	20,000
Pay and allowances of a Game Warden's establishment	5,000
Constitution and maintenance of six sanctuaries ...	20,000
Elephant control	5,000
Total ...	50,000

This is considered to be the minimum sum with which any substantial progress with Wild Life Protection can be effected.

X. CONCLUSION.

Wild Life Protection in Burma is now in a critical state. Factors responsible for the present situation have been discussed and remedial measures have been proposed. Conditions were serious in 1925 but they improved between 1926 and 1931 when a Provincial Game Warden was in office. Now, things are reverting to the state they were in six years ago and prompt action is necessary to prevent irreparable damage from being done.

The lines on which action should be taken have been indicated and the chief constructive acts proposed are tabulated below:—

(1) The re-appointment of a Game Warden with the necessary establishment.

(2) The establishment of a properly co-ordinated system of Elephant Control centralised in a Game Warden.

(3) The centralisation of control of Kheddah Operations in a Game Warden.

(4) The revision of existing legislation and the replacement of the Burma Game Rules, 1927, and the Wild Birds and Animals Protection Act, 1912, by a new Wild Life Protection Act for Burma.

(5) The formation of a Wild Life Protection Society to create a Public Opinion that will demand and support amended legislation.

(6) The constitution of three new Sanctuaries, two primarily for *thamin* and one for tapir.

(7) The transference of control of all Sanctuaries to a National Trust which will develop those suitable for raising to the status of National Parks.

(8) The annual allotment of Rs. 50,000 for expenditure upon Wild Life Protection; the money to be taken from revenue derived from Wild Life Destruction.

'Wild Life Protection' does not mean the 'Artificial Protection' of 'Wild Life'. It means a fight against 'Artificial Destruction'—destruction, that is to say, which is not of Nature's ordering but brought about by ignorance, selfishness, callousness and greed. These are the factors which are destroying the Wild Life Resources of the Province, and which will, if not eliminated, cause the loss of one of Burma's most priceless possessions.

January 10, 1934.

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